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A STUDY OF BIRD INGESTIONS INTO LARGE HIGH BYPASS RATIO
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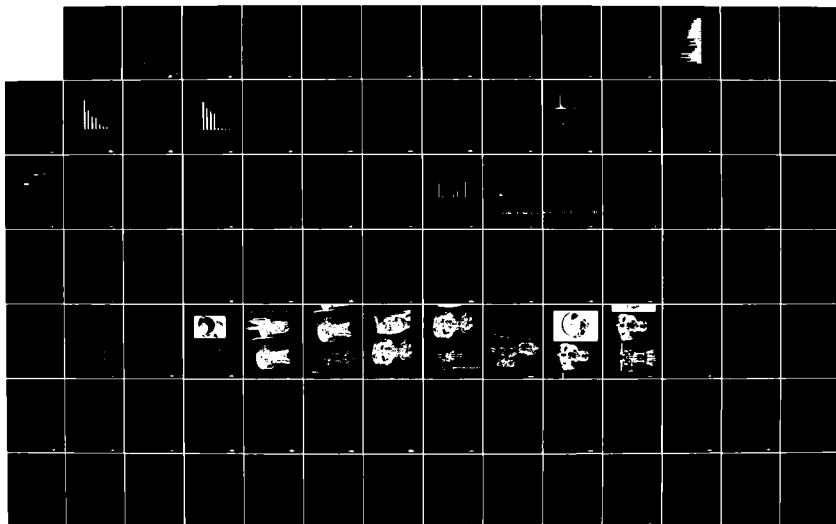
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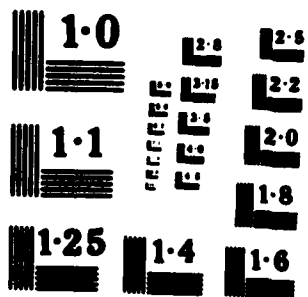
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A Study of Bird Ingestions Into Large High Bypass Ratio Turbine Aircraft Engines

Gary Frings

September 1984

Final Report

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16. Abstract From May 1981 to June 1983, the Federal Aviation Administration (FAA) Technical Center conducted a detailed study of bird ingestions into large high bypass ratio turbine aircraft engines. The worldwide study covered over 2.7 million operations by 1,513 aircraft consisting of the DC8, DC10, B747, B757, B767, A300, A310, and L1011. The objective of this study was to determine the numbers, weights, and species of birds being ingested into these engines and determine what engine damage, if any, resulted. This report presents the findings of this study. ↗			
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EXECUTIVE SUMMARY

An investigation was initiated by the Federal Aviation Administration Technical Center in May 1981 and completed in June 1983, to determine the numbers, weight, and species of birds which are ingested into large high bypass ratio (HBPR) turbine aircraft engines during service operation and determine what damage, if any, resulted.

A total of 1513 HBPR engined aircraft conducted 2.74 million operations during the study period. The aircraft studied were the DC8, DC10, A300, B747, B757, B767, L1011, and A310.

Because there were at least 2.7 million bird ingestion opportunities and only 638 aircraft bird ingestion events were observed, an ingestion is considered a rare (2.33×10^{-4}) but probable event. This represents 233 bird ingestion events per million aircraft operations. Approximately 1.25 million HBPR engined aircraft operations are conducted per year. The monthly distribution of the 638 total worldwide bird ingestion events are shown in figure E-1.

The most commonly ingested family of birds are gulls (Laridae). The majority of the 85 bird species identified during this study are flocking birds. The United States (U.S.) and foreign bird weight distributions are different. The United States bird ingestion rate is significantly lower than the foreign rate. Seasonal changes appear to affect the bird ingestion rate. Wing mounted engines experience significantly more ingestions than center aft mounted engines. Twenty-five airports account for 36 percent of all reported worldwide bird ingestions, and it is noted that 76 percent of all bird ingestions occur in the airport environment during landing and takeoff. The majority of bird ingestions, engine damage, and engine failures occur in the bird weight range of 9 to 24 ounces. Five percent (32) of the reported bird ingestions resulted in engine failure. Analysis reveals that the engine failures cannot be predicted based only on the knowledge of the bird weight and bird numbers. To accomplish this, one must consider factors such as damage tolerance assessments, flight dynamics, and others which were not within the scope of this study. The majority of bird ingestions resulted in either minor or no damage to the engine.

Significant findings resulting from this study are presented below. The detailed discussion of these findings are presented in Section 3 of this report.

Aircraft Bird Ingestion (B.I.) events	638
Engines experiencing B.I.	666
Average bird weight, United States	30 ounces
Average bird weight, foreign	25 ounces
Most commonly ingested bird, United States	Gull
Most commonly ingested bird, foreign	Kite, Gull
Engines which experienced damage (minor and/or major damage)	416
Multiple engine ingestion events per aircraft	25
Multiple birds per engine	65
Takeoff and climb phase-of-flight (for known events)	61%
Approach and landing phase-of-flight (for known events)	36%
Airports where B.I. events occurred	137
Airlines reporting B.I. events	83

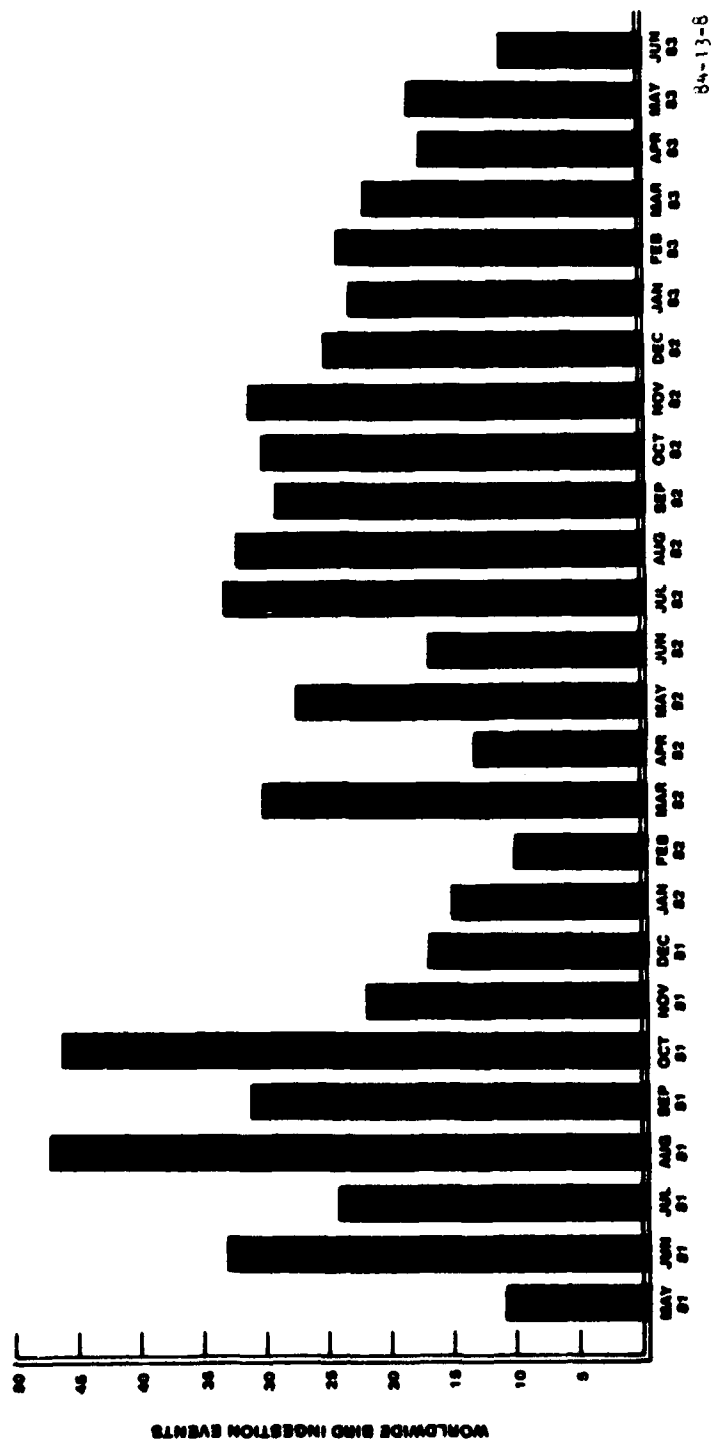


FIGURE E-1. MONTHLY DISTRIBUTION OF WORLDWIDE BIRD INGESTION EVENTS

1. INTRODUCTION.

1.1 BACKGROUND.

National Transportation Safety Board (NTSB) Recommendation A-76-64 was issued April 1, 1976, as a result of an aircraft accident involving a rejected takeoff after "a number of large birds" were ingested into one of the engines. This recommendation stated in part"

"Amend 14 CFR 33.77 to increase the maximum number of birds in the various size categories required to be ingested into turbine engines with large inlets. These increased numbers and sizes should be consistent with the birds ingested during service experience of these engines." (Class III - Longer Term Follow-up)

In response to the Safety Board's subsequent inquiry of July 30, 1980, the Federal Aviation Administration (FAA) on October 30, 1980, summarized the status of the work addressing the recommendation made by NTSB. The FAA had made several examinations of NTSB, FAA, and industry engine records to determine the numbers and weights of birds being ingested into turbine engines with large inlets. These high bypass ratio (HBPR) engines started to enter airline service early in 1969. A study of available records was also made by an Ad-Hoc Committee of the Aerospace Industries Association of America, Inc., in 1978. All of these industry and Government efforts, relying on available records, did not provide the pertinent information necessary to make a decision concerning possible revision of the weights and numbers of birds required to be ingested for engine type certification.

The FAA acknowledged the need for better data relating to the number and weights of birds being ingested in service operation. Because normal reporting activity was not providing sufficient information of this kind, the FAA initiated a special project by the FAA Technical Center. A worldwide data base will be established. This data base, together with other pertinent information, will be used to determine if amendment to existing engine certification standards is warranted.

1.2 OBJECTIVE.

The objective of this investigation was to determine the numbers, weights, and species of birds which are ingested into large high bypass ratio (HBPR) turbine aircraft engines during worldwide service operation and determine what damage, if any, resulted.

1.3 ORGANIZATION OF THIS REPORT.

This report has been organized into four major sections. Section 1 is the Introduction. Section 2, Plans and Procedures, describes the framework utilized in the conduct of this study. Data Analysis and Results are presented in Section 3. Sections 4 and 5 present the summary and conclusions of this report, respectively.

2. PLANS AND PROCEDURES.

2.1 PLAN DESCRIPTION.

This study was limited to engine bird ingestions experienced by large high bypass ratio (HBPR) turbine aircraft engines during worldwide service operations. Therefore, the following guidelines were established to structure an overall plan to conduct this study:

- . Worldwide consideration of data
- . Familiarity with the engine design criteria
- . Proven expertise and prior experience on engine foreign object ingestion interpretation
- . Standardized reporting
- . Minimum impact on the operational fleet
- . Proven expertise in bird identification
- . Airline cooperation and understanding of need
- . Quick response
- . Report of all known engine bird ingestions

Based on these guidelines, it was determined that the most effective approach would be to have the engine manufacturers investigate the bird ingestion incidents on their respective engines. Manufacturing of large high bypass ratio turbine aircraft engines is conducted by Pratt and Whitney Aircraft (PWA), General Electric Company (GE), Rolls Royce, Inc., (RR), and CFM International (CFMI), a joint GE/SNECMA corporation. This offered the benefit of the engine manufacturer's expertise in damage tolerance assessment and will allow them to use their worldwide service organizations to investigate engine ingestion events quickly.

The information in this study was obtained by the manufacturers in cooperation with the Air Transport Association of America (ATA) and the International Air Transport Association (IATA) and their member airlines. Whenever possible, the engine manufacturers used the services of a recognized ornithologist to identify the bird species. This study spanned twenty-six (26) months from May 1981 to June 1983.

2.2 ASSUMPTIONS, COVERAGE, AND EXPOSURE DEFINITIONS.

2.2.1 Assumptions. In order to meet FAA information needs as well as data analysis objectives of this study, a framework for the data collection was established. This framework consisted of the following assumptions:

1. This study will be a census of the worldwide bird ingestion events.
2. A bird ingestion event is a rare but probable phenomenon. Few such events are expected.
3. The bird characteristics, i.e., the number, weight, and species must be determined.

2.2.2 Coverage. The aircraft with HBPR engines in service during the study period constituted the total population of this study. The four engine models — JT9D (PWA), CP6 (GE), RB.211 (RR), and CFM 56 (CFMI) — were arbitrarily assigned a coding of one through four for the engine identifier. The eight aircraft types studied were also encoded in the data base but will be identified by name in this report. The aircraft types are McDonnell-Douglas DC8-70 series and DC10; Boeing B747, B757, B767; Airbus A300 and A310; and Lockheed L1011.

A comparison of relative size, shape, and engine position for these HBPR engined aircraft is shown in appendix A. The distribution of these aircraft is shown in figure 2.1. The engine distribution by make and model for these aircraft are shown in table 2.1.

2.2.3 Exposure. During the development of the analysis plan, it became apparent that bird ingestion incidence data by itself will not be useful unless some measure of exposure is defined. In other words, to understand the magnitude of the bird ingestion problem it is essential to determine the level to which the aircraft in table 2.1 was exposed, on a worldwide bases, to potential bird ingestions. To compare and contrast the bird ingestion rates of the various aircraft types, it was necessary to determine the total number of operations conducted during the study period. An "operation," as used in this study, is contrary to normal Federal Aviation Administration (FAA) practice. A flight, for example, from airport "A" to airport "B" is counted as one operation. The main source used in determining numbers of operations was the Official Airline Guide (OAG) computer tapes, which are updated every month. These tapes were used to identify the airline schedules and provide data such as aircraft type, departure and arrival airports, frequency of flight, and domestic/foreign operations. To validate the accuracy of the OAG operational data, engine manufacturers' data were used as a cross-check. Their operational count was 6.3 percent higher (163,000 operations) than the OAG data. Further investigation revealed that 92,000 of these operations involved the B747 aircraft which is extensively used for freighter operations and, therefore, not always included in OAG data. The data reported in this study include freighter operations. Worldwide, approximately 2.7 million operations occurred during the study period. This constituted the total exposure for the bird ingestion phenomenon to occur for the worldwide HBPR engined aircraft fleet. The worldwide operations by aircraft type is shown in figure 2.2.

2.3 DATA ADEQUACY.

In order to determine if sufficient data had been collected to allow conclusions to be formulated, the following guidelines were established:

- . Sufficient data to allow a reliable assessment of the bird ingestion phenomenon.
- . Sufficient data to conduct a statistical analysis based upon the numbers, weights, and species of birds.
- . Sufficient data to conduct a statistical analysis of the engine damage resulting from a bird ingestion — considering the bird number, weight, and species.
- . Sufficient data to conduct a statistical analysis of the year-to-year variation (if any) of the bird ingestion phenomena.

Based on these guidelines, it was reported at the end of the first year's data collection effort (reference 1) that the data base at that time appeared to be inadequate, in most instances, to allow conclusions to be formulated. It was not known at the time if the first year's bird ingestion data were representative of the ingested bird population distribution for a typical year. For these reasons, the data collection effort was extended for another fourteen (14) months. A comparison of the first and second year's cumulative distribution of ingestion events is presented in table 2.2 and graphically represented in figure 2.3.

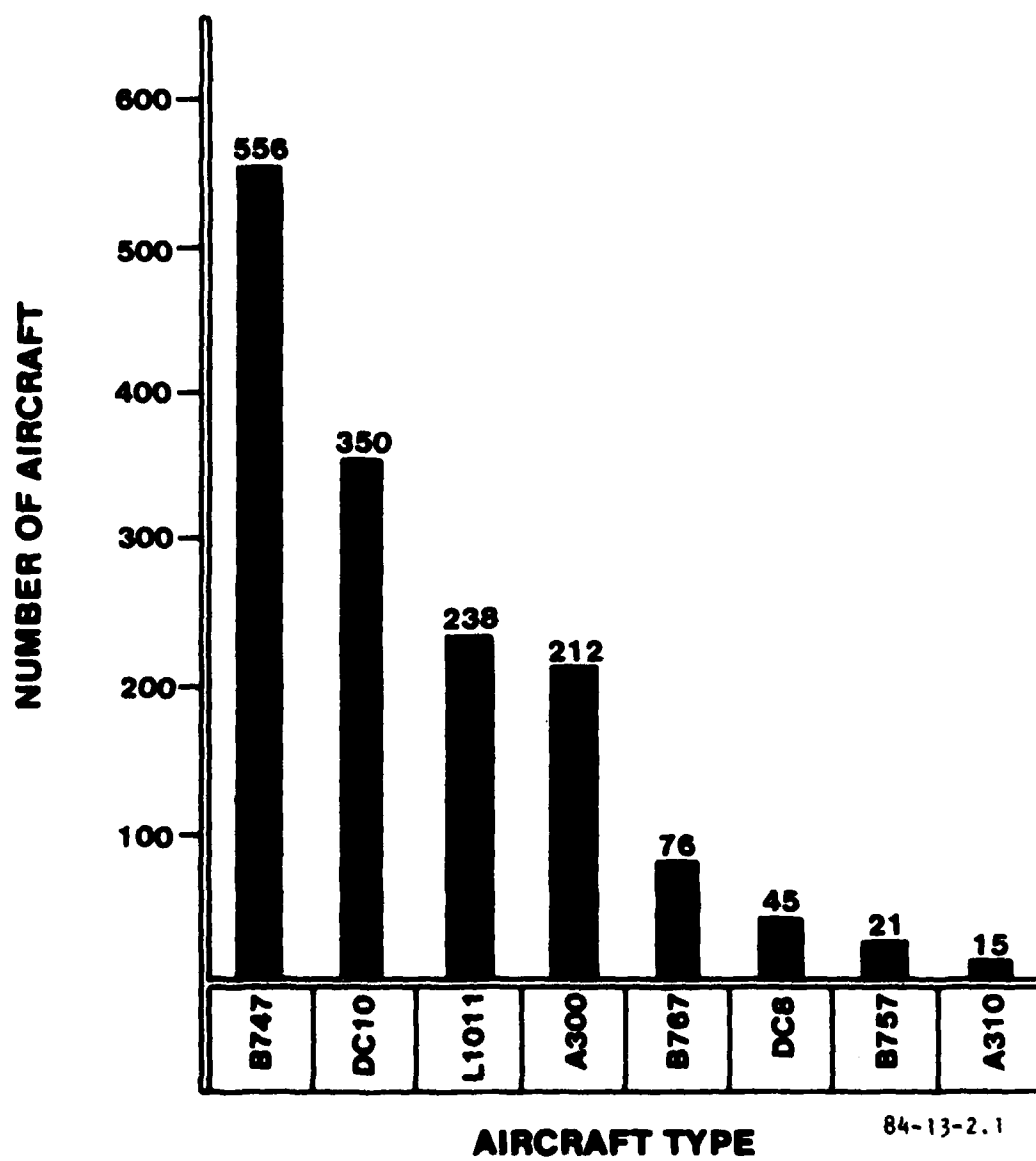


FIGURE 2.1 AIRCRAFT DISTRIBUTION

TABLE 2.1 NUMBERS OF AIRCRAFT AND HBPR ENGINES IN SERVICE AS OF JUNE 30, 1984

	DC8	DC10	A300	B747	B757	B767	L1011	A310
PWA JT9D -3,-7				326				
JT9D -70,-7Q*				86				
JT9D -59		20	23					
JT9D -20		22						
JT9D -7R4				7		49		6
Aircraft Sub-Total		42	23	419		49		6
Engine Sub-Total		126	46	1676		98		12
GE CF6 -6		127						
CF6 -50*		181	189	93				
CF6 -80						27		9
Aircraft Sub-Total		308	189	93		27		9
Engine Sub-Total		924	378	372		54		18
RR RB.211 -22B							160	
RB.211 -524*				44			78	
RB.211 -535*					21			
Aircraft Sub-Total				44	21		238	
Engine Sub-Total				176	42		714	
CFMI CFM56 -2*	45							
Aircraft Sub-Total	45							
Engine Sub-Total	180							
Total Aircraft	45	350	212	556	21	76	238	15
Total Engines	180	1050	424	2224	42	152	714	30

Grand Aircraft Total - 1513, Grand Engine Total - 4816 (PWA - 1958, GE - 1746, RR - 932, CFMI - 180)

* Shown pictorially in appendix B.

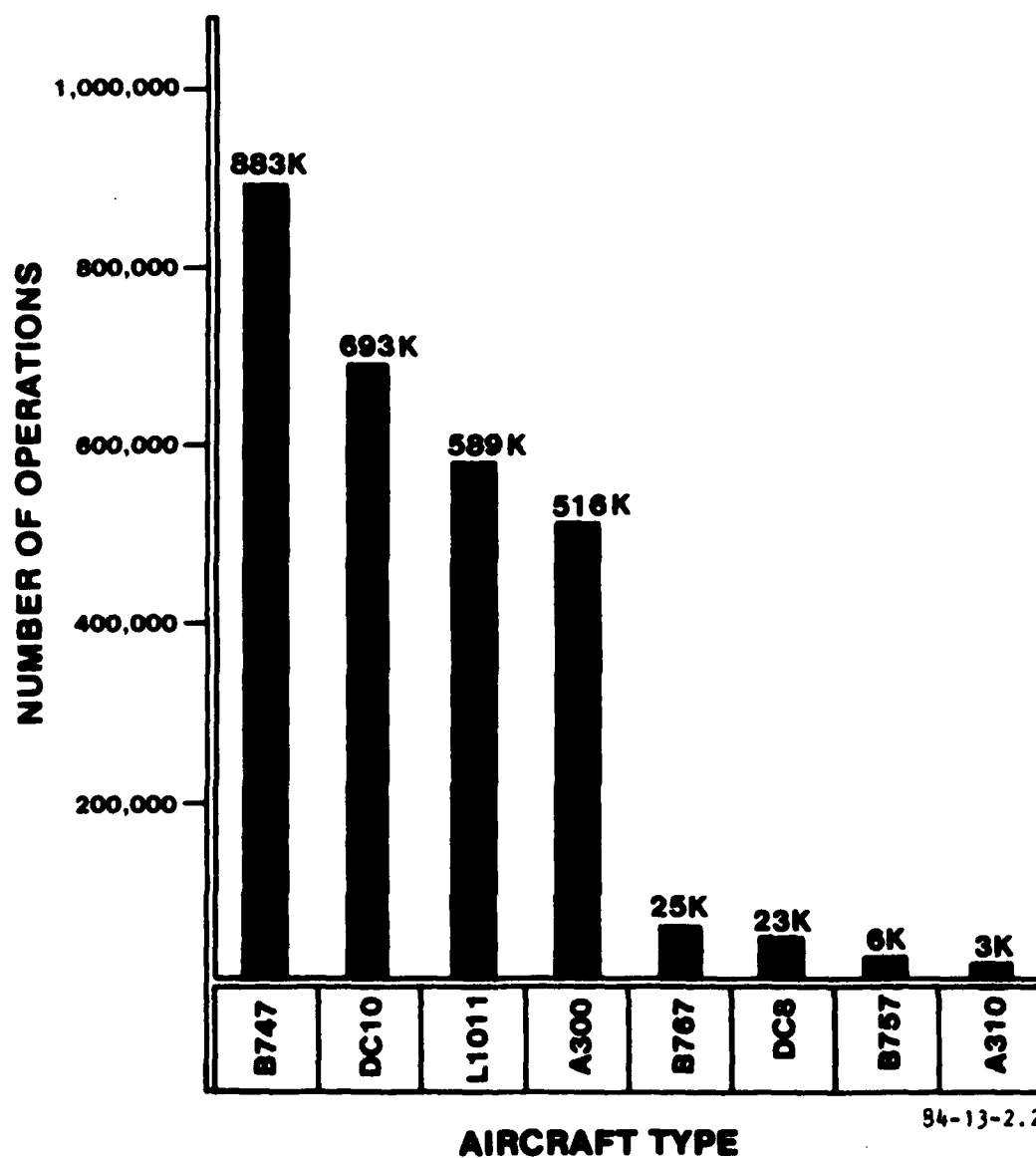
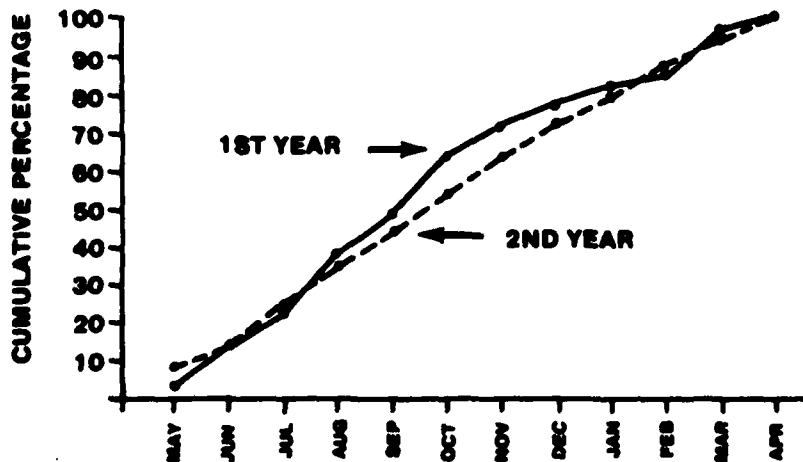


FIGURE 2.2 OPERATIONAL DISTRIBUTION

TABLE 2.2 CUMULATIVE DISTRIBUTION OF INGESTION EVENTS
FOR 1ST AND 2ND YEAR

Year 1			Year 2		
Month	Events	Cum. %	Month	Events	Cum. %
May 81	11	3.7	May 82	27	8.7
Jun 81	33	14.7	Jun 82	17	14.2
Jul 81	24	22.7	Jul 82	33	24.8
Aug 81	47	38.5	Aug 82	32	35.2
Sep 81	31	48.8	Sep 82	29	44.5
Oct 81	46	64.2	Oct 82	30	54.2
Nov 81	22	71.6	Nov 82	31	64.2
Dec 81	17	77.3	Dec 82	25	72.3
Jan 82	15	82.3	Jan 83	23	79.7
Feb 82	10	85.6	Feb 83	24	87.4
Mar 82	30	95.7	Mar 83	22	94.5
Apr 82	13	100.0	Apr 83	17	100.0
Total	299			310	



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FIGURE 2.3 CUMULATIVE DISTRIBUTION OF 1ST AND 2ND YEAR BIRD INGESTION EVENTS

In order to ascertain whether the bird ingestions event distributions were the same for both year 1 and year 2, the non-parametric test of Kolmogorov-Smirnov was employed. The details of this test are presented in appendix C. The test shows that at a significant level of five (5) percent, we can safely state that there is no difference in the empirical distribution shown in figure 2.3 for year 1 and year 2. Therefore, both of these distributions are drawn from a common parent distribution. Revised (different time span) first and second year cumulative distributions are presented in table 2.3 and in figure 2.4. The statistical test cited above affirms the same conclusion for this revised data as was reached above.

Based upon these results, it was decided not to collect further bird ingestion data because it was apparent that the data which had been collected were representative for both years of the worldwide bird ingestion environment for the aircraft types studied. Had this study been extended one or possibly two more years a significant shift in the bird distribution characteristics would not be expected. Additional bird ingestion data collection may be required for the newer aircraft and/or engine models which have recently entered commercial revenue service (DC8-70 series, B757, B767, A310) because of their limited exposure history as evidenced by figures 2.1 and 2.2.

3. DATA ANALYSIS AND RESULTS.

3.1 DESCRIPTION OF ANALYSIS CATEGORIES.

The analysis of the data presented in the following sections is confined to five (5) major categories:

- . Characteristics of Ingested Birds
- . Ingestion Rates
- . Airport Bird Ingestion Experience
- . Engine Damage and Failure Description
- . Probability Estimate of Bird Ingestion Related Events

Various analytical techniques were employed to manage the more than 15,000 pieces of information collected during the twenty-six (26) months of this bird ingestion study. These analytical techniques are briefly described in appendix C. The use of these techniques required only minimal assumptions of the underlying statistical distributions of these data and only a generalized knowledge of bird habits. Delineating all the factors relating to bird ingestions contained in the 15,000 pieces of information was not attempted.

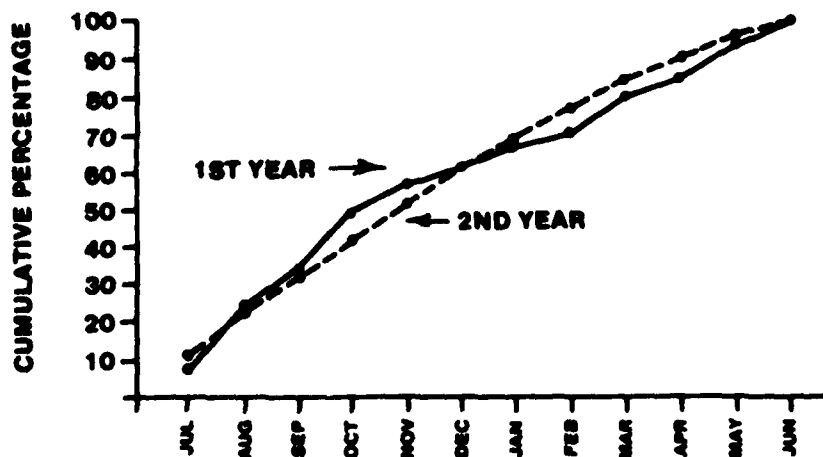
3.2 CHARACTERISTICS OF INGESTED BIRDS.

3.2.1 Bird Types. The identification of the types and sizes of birds being ingested into high bypass ratio engines was the prime objective of this report. Appendix D was constructed to give engineers, ornithologists, airport managers, aircraft flight personnel, and other interested parties in the aircraft engine bird ingestion phenomenon a standardized description of the order, family, and species of birds encountered, typical estimated weights, and frequency of occurrence. References 2, 3, and 4 were used extensively in structuring appendix D. It was recognized, while constructing this appendix, that considerable weight variations may be found among individual birds of any one species. The weights shown in appendix D represent an assessment of the average weights based on

TABLE 2.3 CUMULATIVE DISTRIBUTION OF INGESTION EVENTS
FOR REVISED 1ST and 2ND YEAR

Year 1			Year 2		
Month	Events	Cum. %	Month	Events	Cum. %
Jul 81	24	8.0	Jul 82	33	11.2
Aug 81	47	23.6	Aug 82	32	22.0
Sep 81	31	34.1	Sep 82	29	31.9
Oct 81	46	49.5	Oct 82	30	42.0
Nov 81	22	56.9	Nov 82	31	52.5
Dec 81	17	62.5	Dec 82	25	61.0
Jan 82	15	67.5	Jan 83	23	68.8
Feb 82	10	70.9	Feb 83	24	76.9
Mar 82	30	80.9	Mar 83	22	84.4
Apr 82	13	85.3	Apr 83	17	90.2
May 82	27	94.3	May 83	18	96.3
Jun 82	17	100.0	Jun 83	11	100.0
Total	299			295	

*This table excludes first two months of data (namely April 81 and May 81).



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FIGURE 2.4 CUMULATIVE DISTRIBUTION OF REVISED 1ST AND 2ND YEAR
BIRD INGESTION EVENTS

the available information from references 3 and 4, and weight information submitted by the engine manufacturers on individual bird ingestion events.

During the course of this study, 85 bird species were identified as having been involved in aircraft engine ingestions. The overwhelming majority of these species (79) are flocking birds or birds which group together on the ground (in this case, the airport) after feeding or while resting. Flocking and grouping birds present the greatest hazard to aircraft. The most hazardous family of birds, in terms of aircraft engine ingestions, is Laridae (gulls, etc.) which alone account for 35 percent of all engine ingestions. The gulls are closely followed by Accipitridae (kites, etc.) which account for 20 percent of all ingestions. Examination of appendix E shows that two- and three-engine bird ingestions are almost all caused by flocking bird species.

Appendix F offers a visual perspective of the morphology of the most commonly ingested birds. The birds depicted in this appendix represent species which have been ingested five or more times. These birds are shown relative to their sizes measured from the tip of the bill to the tip of the tail.

It has been possible to validate the bird weight in over 50 percent of the bird ingestions. Bird remains were collected from the engines by the manufacturers and sent to the Smithsonian Institution for identification and analysis by an ornithologist. From the remains, the ornithologist not only determined species but in many cases also sex and maturity. This information, together with location and time of year, enabled the ornithologist to determine a range of weights for the bird(s). The majority of bird weights reported in this study are the midpoints of the range of weights as reported by the ornithologist.

3.2.2 Bird Weight Distribution. Figure 3.1 shows the worldwide distribution of bird weights and also highlights the average, most likely, and median bird weights. The average bird weight per event was calculated by summing all known bird weights which appeared for each event and dividing this result by the number of events. The most likely weight is that weight which occurs the most frequently. The weight at which an equal number of weights occur, both above and below it, is called the median weight. It should be noted that with the exception of the very heavy, large birds (vultures, eagles, storks, herons, geese, etc.) which are shown in figure 3.1 as weighing more than 64 ounces (>64), the bird weight distribution is very sparse above 40 ounces (2.5 pounds). Figure 3.1 also shows that a disproportionate number of events occur at discrete weights. In many of these cases, the weight is peculiar to certain bird species. For example, 10 and 11 ounces - black-headed gulls, silver gulls; 16 ounces - pigeons, rock doves, ring-billed gulls; 20 ounces - crows, black-tailed gulls; 24 and 28 ounces - black kite; 32 ounces - red kite, pintail duck, lesser black-backed gull, black kite; 36 and 40 ounces - Herring gull, red kite, mallard duck.

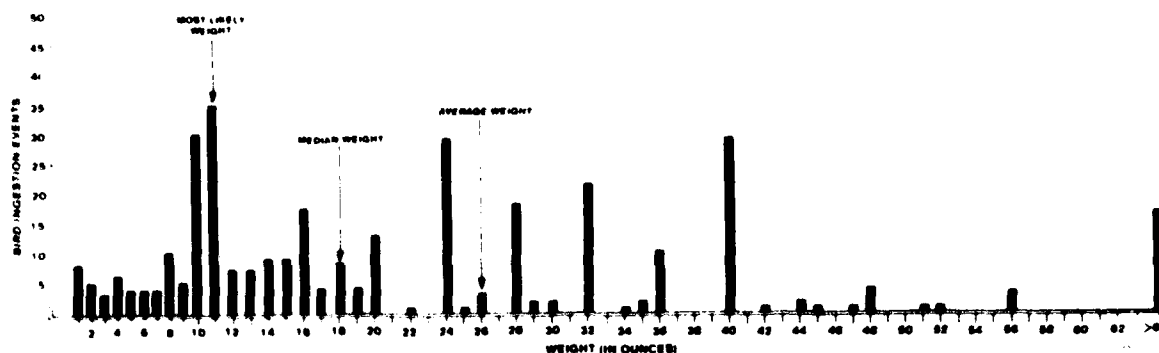


FIGURE 3.1 WORLDWIDE DISTRIBUTION OF BIRD WEIGHTS

A summary of the bird weights, United States versus foreign is presented in table 3.1.

TABLE 3.1 BIRD WEIGHT SUMMARY

	<u>U.S.</u>	<u>Foreign</u>	<u>Unknown</u>	<u>Worldwide</u>
Number of Events	97	494	47	638
Known Weight Events	66	254	19	339
Average Bird Weight Per Event	30 oz.	25 oz.	20 oz.	26 oz.
Most Likely Bird Weight	40 oz.	11 oz.	*	11 oz.
Median Bird Weight	34 oz.	17 oz.	15 oz.	18 oz.

* No single weight can be identified (see figure 3.2), observations are limited.

3.2.3 Bird Distribution, United States Versus Foreign. The weight distribution, by origin of ingestion, is presented in table 3.2 and figure 3.2. The cumulative weight distribution by bird origin is presented in table 3.3 and figure 3.3.

To determine if these two bird weight distributions shown in figure 3.3, United States versus foreign, are similar, an appropriate statistical test the Kolmogorov-Smirnov (K.S.) two-sample test is applied. This test is concerned with the agreement between two sets of sample values. Two weight samples drawn from the same weight population distribution, should show that the cumulative distributions of both weight samples may be expected to be fairly close to each other and should show only random deviations from the weight population distributions. Should the cumulative weight distributions of the two samples diverge too much at any point,

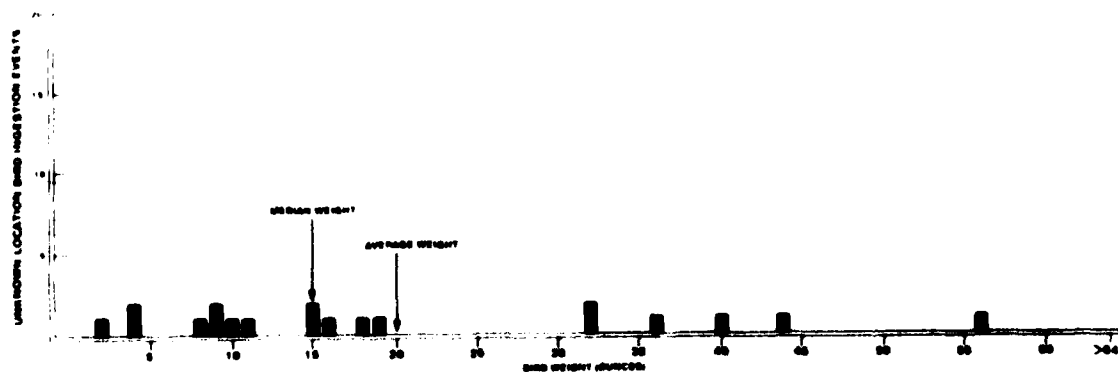
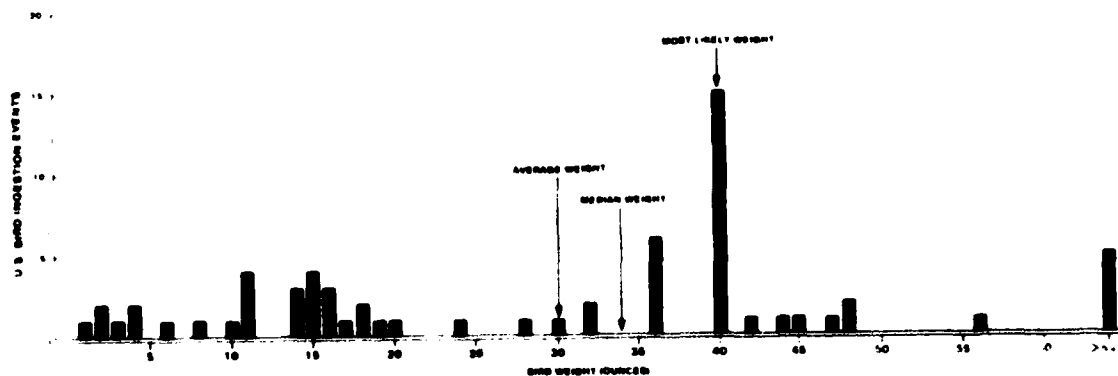
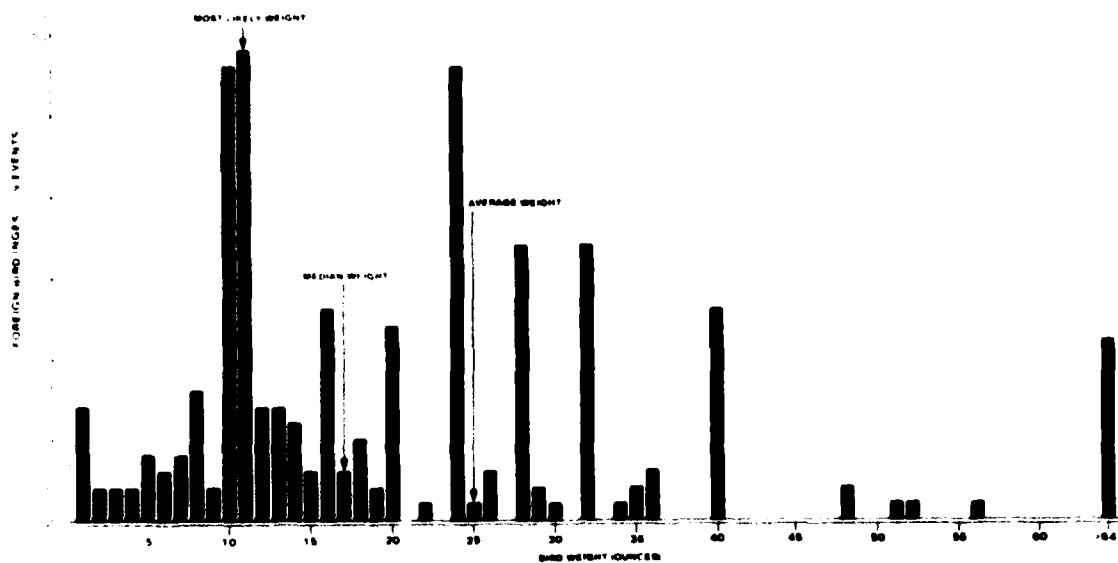


FIGURE 3.2 BIRD WEIGHT DISTRIBUTION BY ORIGIN OF INGESTION

TABLE 3.2 WEIGHT DISTRIBUTION OF BIRD INGESTION EVENTS BY ORIGIN

<u>Weight (oz.)</u>	<u>U.S.</u>	<u>Foreign</u>	<u>Unk.</u>	<u>World</u>
1-4	6	13	3	22
5-8	2	19	1	22
9-12	5	66	4	75
13-16	10	29	3	42
17-20	5	22	2	29
21-24	1	29	0	30
25-28	1	21	0	22
29-32	3	20	2	25
33-36	6	6	1	13
37-40	15	13	1	29
41-44	2	0	1	3
45-48	4	2	0	6
49-52	0	2	0	2
53-56	1	1	1	3
57-60	0	0	0	0
61-64	0	0	0	0
> 64	5	11	0	16
TOTAL	66	254	19	339

TABLE 3.3 CUMULATIVE WEIGHT DISTRIBUTION BY BIRD ORIGIN

<u>Bird Weight</u>	<u>U.S. Cumulative Percentage</u>	<u>Foreign Cumulative Percentage</u>
< 5 oz.	9.1	5.1
< 9 oz.	12.1	12.6
<13 oz.	19.7	38.6
<17 oz.	34.8	50.0
<21 oz.	42.4	58.7
<25 oz.	43.9	70.1
<29 oz.	45.5	78.3
<33 oz.	50.0	86.2
<37 oz.	59.1	88.6
<41 oz.	81.8	93.7
<45 oz.	84.9	93.7
<49 oz.	90.9	94.5
<53 oz.	90.9	95.3
<57 oz.	92.4	95.7
<61 oz.	92.4	95.7
<65 oz.	92.4	95.7
<240	100	100

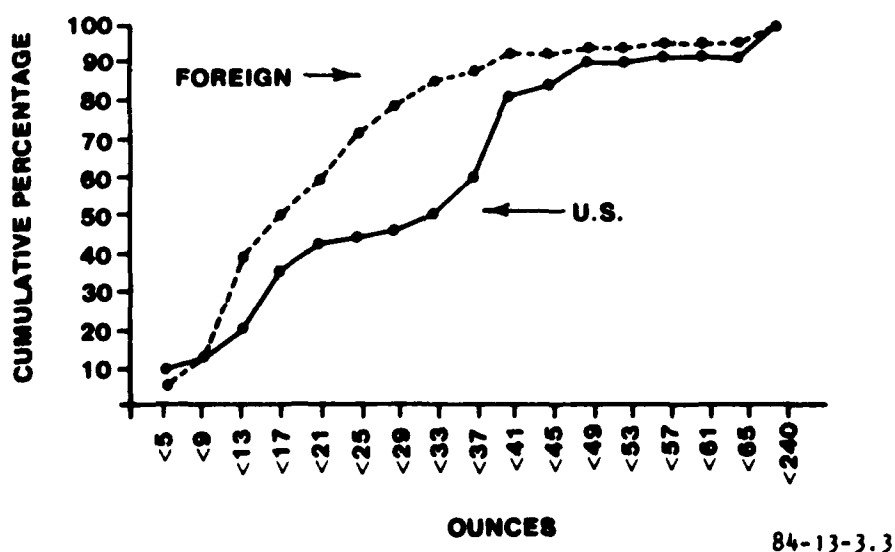


FIGURE 3.3 CUMULATIVE DISTRIBUTIONS OF U.S. AND FOREIGN BIRD WEIGHTS

it would indicate that the observations came from different bird weight distributions. Figure 3.3 clearly shows that large weight deviations exist between the two observed distributions. The largest deviation, 36.2, occurs at cumulative weight interval, <29 ounces. At a significance level of 5 percent, the K.S. test shows that these two distributions are significantly different, that is, the parent distributions (U.S. and foreign) of bird weights are not the same. The weight distributions of foreign, United States, and unknown location bird ingestion events, which were presented in figure 3.2 further enhances this inference.

3.2.4 Seasonal Bird Ingestion Effects. In order to determine seasonal effects on bird ingestion, three factors had to be taken into consideration. First, the northern and southern hemispheres experience opposite seasons. Second, aircraft operational counts increase during the summer months. Third, the operational count steadily increased during the course of this study, due to the lifting of restrictions caused by the air traffic controllers strike of 1981, thereby making it difficult to compare annual seasonal variations.

The seasons were defined for the northern and southern hemispheres as per table 3.4. Inspection of the operational data for this study period revealed that, worldwide, the operational count increased approximately 5 to 10 percent during the summer months when compared to the winter months. Unfortunately, the operational data by season for northern and southern hemispheres were not readily available, but it was determined that the vast majority of aircraft operations for this study were conducted in the northern hemisphere.

TABLE 3.4 SEASONAL DEFINITIONS

<u>Season</u>	<u>Northern Hemisphere</u>	<u>Southern Hemisphere</u>
Spring	March - May	September - November
Summer	June - August	December - February
Fall	September - November	March - May
Winter	December - February	June - August

The ingestion events data were divided into two seasonal cycles. The first cycle contains the ingestion data for the first year of this study (June 1981 - May 1982) and the second cycle contains the ingestion data for the second year of this study (June 1982 - May 1983). These two cycles were compared to each other, first in the northern hemisphere. No seasonal adjustments are necessary for this comparison. The cycles were then compared to each other for both hemispheres combined (worldwide) in conformance with the seasonal definitions set forth in table 3.4. The resulting ingestion events for the northern hemisphere and worldwide (combined hemispheres) are presented in table 3.5 for each of the two cycles.

TABLE 3.5. INGESTION EVENTS BY SEASON

Northern Hemisphere					
<u>Cycle</u>	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>	<u>Spring</u>	<u>Total</u>
First Cycle	98	94	40	63	295
Second Cycle	77	88	59	53	277
Total	175	182	99	116	572

Worldwide					
<u>Cycle</u>	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>	<u>Spring</u>	<u>Total</u>
First Cycle	100	101	46	63	315
Second Cycle	90	92	64	55	301
Total	190	193	110	123	616

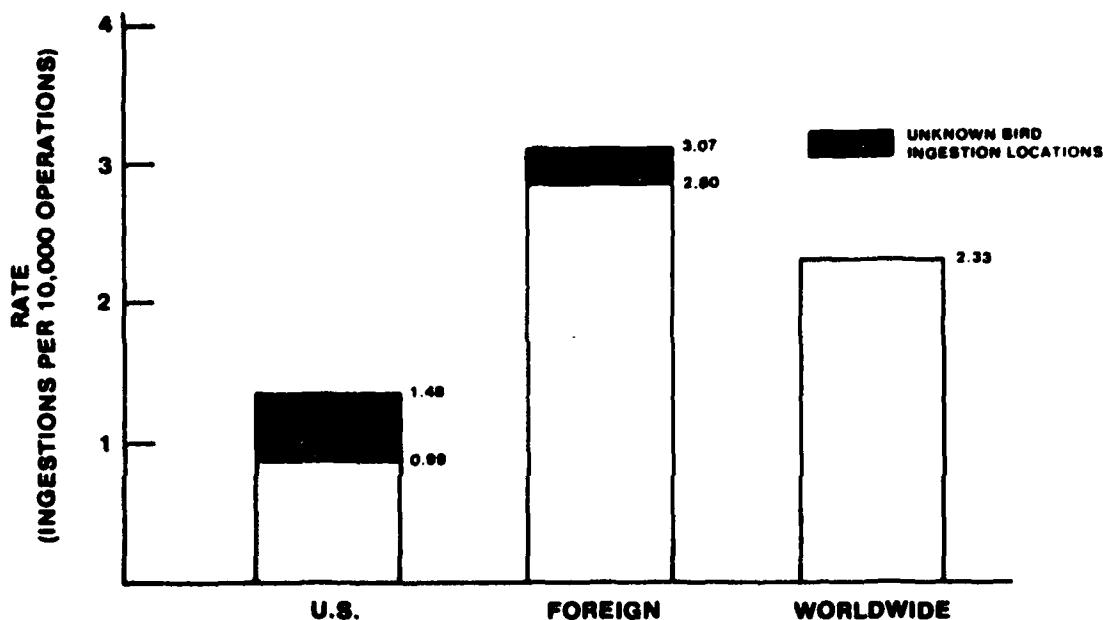
The hypothesis of interest is to determine whether the seasonal ingestion event distributions for the first cycle and the second cycle are the same. For testing this type of hypotheses the chi-square test (appendix C) for homogeneity of two samples was employed. The chi-square values obtained for the northern hemisphere and worldwide are 6.67 and 4.95, respectively, which are not significant at the 95 percent confidence level. Therefore, we can conclude that there are no difference between the two seasonal cycles.

However, this does not imply that there are no differences among the seasons within the cycle itself. In fact, if there were no seasonal effects, the ingestion events should be evenly distributed among the four seasons. An inspection of table 3.5 indicates that during the winter season the ingestion events are significantly less than the summer and fall seasons. The statistical test strongly indicates that ingestion events by season within each of the cycles are heterogeneous and, therefore, seasonal effects on the ingestion phenomenon are not negligible.

3.3 INGESTION RATES.

3.3.1 Bird Ingestion Rates, United States Versus Foreign. Engine bird ingestion rates indicate that the United States and foreign bird environments are not the same. A comparison of United States, foreign, and worldwide bird ingestion rates are summarized in figure 3.4. The United States bird ingestion rate is approximately one-third to one-half of the foreign bird ingestion rate, even taking into account those bird ingestions for which locations are unknown (cross-hatched area). The fact that the United States operations count is approximately one-third (35.6 percent - table 3.6) of the total worldwide count, does not explain the difference in the United States versus foreign bird ingestion rates. Examination of table 3.6 shows that the DC10 and L1011 aircraft have approximately equal operations in both the United States and foreign environments, yet both aircraft types display a higher (by a factor greater than 2) foreign ingestion rate than United States ingestion rate. All aircraft types studied exhibited lower ingestion rate while

operating in the United States environment than in the foreign environment. The exceptions to this are the B757 and A310 which did not operate extensively in both environments during the course of this study.



84-13-3.7

FIGURE 3.4 U.S. FOREIGN AND WORLDWIDE BIRD INGESTION RATES

TABLE 3.6 INGESTION RATES BY AIRCRAFT TYPE

Aircraft Types	Ingestion Events				Operations			Rates/10K Operations		
	U.S.	Foreign	Unk	World	U.S.	Foreign	World	U.S.	Foreign	World
DC8	1	1	0	2	17,047	5,682	22,729	0.59	1.76	0.88
DC10	25	66	6	97	338,475	354,142	692,616	0.74	1.86	1.40
A300	10	133	1	144	78,841	437,405	516,246	1.27	3.04	2.79
B747	34	234	29	297	237,754	645,396	883,150	1.43	3.63	3.36
B757	1	0	0	1	3,079	3,321	6,400	3.25	0.00	1.56
B767	3	1	0	4	22,584	2,554	25,138	1.33	3.92	1.59
L1011	23	57	11	91	277,679	311,321	589,000	0.83	1.83	1.54
A310	0	2	0	2	0	3,040	3,040	0.00	6.58	6.58
Total	97 (15.2%)	494 (77.4%)	47 (7.4%)	638 (100.0%)	975,459 (35.6%)	1,762,861 (64.4%)	2,738,320 (100.0%)	0.99	2.80	2.33

The United States ingestion rate is much lower than the foreign ingestion rate. The statistical test for comparing two Poisson rates (appendix C) indicates that the difference between the United States and foreign rates, under the assumption that these rates are equivalent, is highly unlikely. In other words, the difference noted is not due to random variation but strongly suggests that these rates describe two distinct Poisson distributions. The United States bird environment appears to be different from the foreign bird environment. Table 3.7 presents a summary of these rates.

TABLE 3.7 SUMMARY OF OPERATIONS, EVENTS, AND INGESTION RATES FOR KNOWN LOCATIONS (INGESTION EVENTS BY SELECTED AIRCRAFT TYPES)

	<u>Aircraft Types</u>					
	<u>DC10</u>	<u>A300</u>	<u>B747</u>	<u>B757</u>	<u>B767</u>	<u>L1011</u>
U.S. Operations	256,902	86,530	193,580	1,879	11,158	202,802
Events	21	6	27	1	2	15
Rates/10K Ops	0.82	0.69	1.40	5.32	1.79	0.74
Foreign Operations	269,354	329,164	511,205	1,505	2,004	175,288
Events	50	97	167	0	1	40
Rates/10K Ops	1.86	2.95	3.37	0.00	4.99	2.28

NOTE: Airport statistics given in this table pertain to only those airports which are identified in appendix E. The airports designated (XUS) Unknown United States, (XFO) Unknown Foreign, and (XXX) Unknown location, are excluded from this table. No airport operations data were available for the DC8 and A310 aircraft.

3.3.2 Comparison Of Bird Ingestion Rates By Aircraft Type.

3.3.2.1 Engine Position. A unique feature of this data gathering effort has been the opportunity to study the bird ingestion phenomenon from the standpoint of aircraft which are engined in three basically different configurations (appendix A). These configurations are: two-wing mounted engines (A300, A310, B757, B767), two wing- and one tail-mounted engine (DC10, L1011), and four wing-mounted engines (B747, DC8). It is of interest to determine whether or not the aircraft engine configuration has an impact on the bird ingestion rate which these aircraft experience. Table 3.6 presented the bird ingestion rates for these aircraft. This analysis is confined to the DC10, A300, B747, and L1011 for which there is sufficient operational and bird ingestion data. The other aircraft have not been in service long enough.

Figure 3.5 presents the bird ingestion location by engine position for the four aircraft types under consideration. The number 2 (center) engine position of the DC10 and L1011 aircraft experienced relatively few bird ingestions when compared to positions 1 and 3. The DC10 experienced 97 ingestion events and only one of these involved the center aft engine (one percent). The L1011 experienced 91 ingestion events and 9 of these involved the center aft engine (10 percent). Figure 3.5 shows the fairly even distribution of bird ingestions among the four aircraft and engine locations under consideration. That the center aft engine location of the DC10 and L1011 aircraft experience relatively few ingestions indicates that this phenomenon is engine position dependent. From the bird ingestion phenomena point of view, these two aircraft types may be considered to have only two engines.

Table 3.6 also showed that the B747 aircraft exhibits the highest bird ingestion rate of all the aircraft types under consideration. Since the B747 is a four-engine (all wing-mounted) aircraft, it should exhibit approximately twice the ingestion rate of the DC10, L1011, or A300. In order to determine the validity of such a hypothesis, the operating environment of the B747 was investigated.

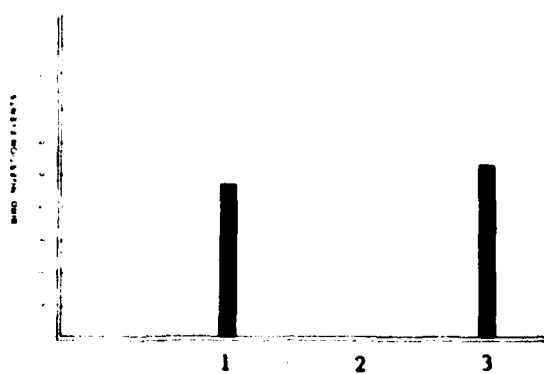
It was determined that the B747 aircraft experienced bird ingestions at 72 known airport locations. The B747 bird ingestion rate at these locations was compared to the bird ingestion rate of the other three aircraft types at the same 72 airports. Table 3.8 presents this data and shows that the B747 ingestion rate, in its exclusive set of 72 airports, is over twice the rate of the DC10 and L1011. The ratio between the A300 and B747 is approximately 1 to 1.7. This suggests that the B747, which has twice the number of wing-mounted engines compared to these other aircraft types, experiences approximately twice the exposure risk. Thus, it is highly probable that four wing-mounted engines will result in greater numbers of bird ingestion events (by a factor of approximately two) than only two wing-mounted engines while operating in a comparable environment.

TABLE 3.8 COMPARISON OF BIRD INGESTION RATES BASED UPON B747 INGESTION LOCATIONS

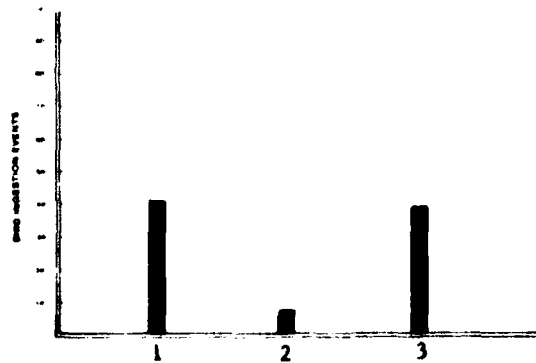
	<u>DC10</u>	<u>A300</u>	<u>B747</u>	<u>L1011</u>
Operations	344,344 (49.7)	269,617 (52.2)	616,954 (69.9)	249,750 (42.4)
Bird Ingestion Events	42	51	194	33
Ingestion Rate/ 10K Ops.	1.22	1.89	3.14	1.32

Note: () denotes percent of total worldwide operations per aircraft type for 26 months.

Figure 3.5 presents a summary of the engine positions which experienced bird ingestions by aircraft type.



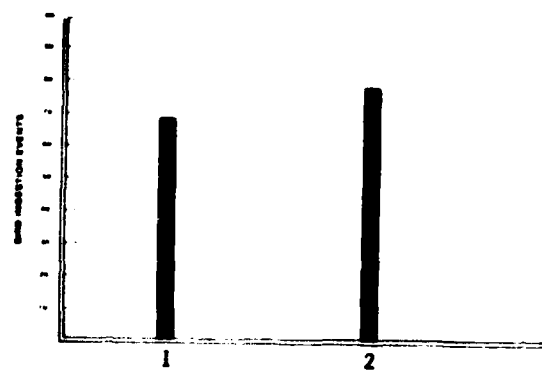
(a) DC10 Aircraft



(b) L1011 Aircraft



(c) B747 Aircraft



(d) A300 Aircraft

FIGURE 3.5 BIRD INGESTION FREQUENCY VERSUS ENGINE POSITION

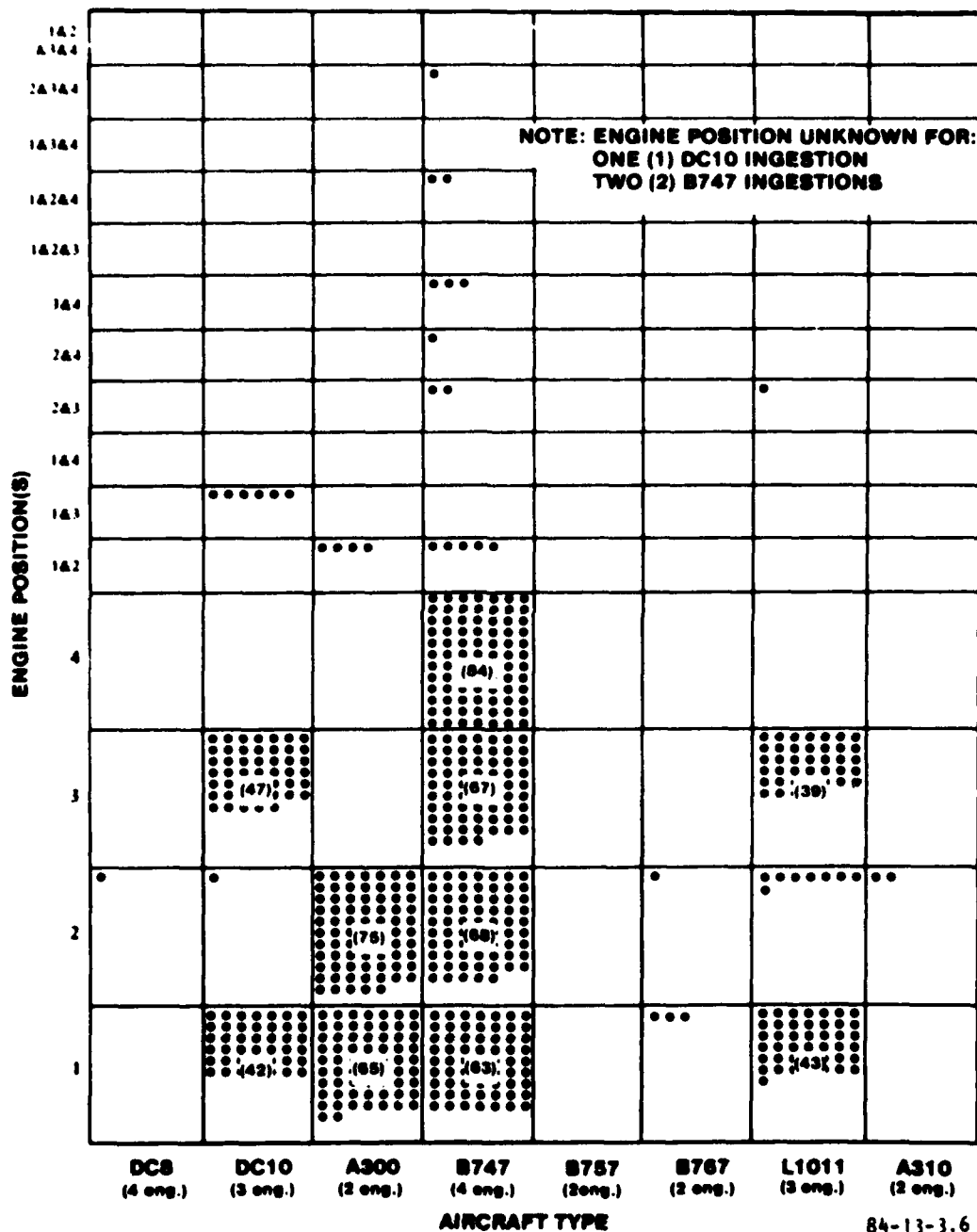


FIGURE 3.6 ENGINE POSITIONS WHICH EXPERIENCED BIRD INGESTIONS

3.3.2.2 Aircraft Operational Environment. In order to assess the effects of the aircraft operational environment on the ingestion rates, tables 3.9 and 3.10 were developed. Table 3.9 addressed only those airport locations where it is known that an ingestion had taken place. Table 3.10 addresses those airports also, however, the ingestions which occurred at unknown locations are also included in this table. For example, it is shown in both tables that the DC10 aircraft served 114 airports with a corresponding operations count of 526,256. Table 3.9 shows that known location ingestions occurred at only 47 of these airports with a corresponding operations count of 338,642. Additionally, 71 ingestions can be attributed to these 47 airports yielding an ingestion rate of 2.10. Continuing this example for the DC10, it can be seen that in table 3.10, 97 ingestions were now attributed to these same 47 airports, yielding an ingestion rate of 2.86. Adding those DC10 ingestions for which the geographic locations are unknown, under the assumption that the unknown location ingestions occurred at these airports, increases the rate.

Tables 3.9 and 3.10 present similar data for the A300, B747, and L1011. The ingestion rates shown in these tables reflect those rates which the aircraft experience in their respective operational environments. Certain airports may or may not be common to all aircraft types under consideration. In general, the ingestion rates vary considerably among the aircraft types studied. In other words, this aircraft operational environmental assessment suggests that there are considerably different rates that could be attributed to routing structure and many other factors which were not explicitly examined during this study.

3.3.3 Multiple Engine Bird Ingestion Rates, United States Versus Foreign. There were a total of 25 multiple engine ingestions, that is, birds were ingested into more than one engine per aircraft. Twenty-two events occurred wherein two engines ingested birds. Three events occurred wherein three engines ingested birds. The geographic ingestion location of two of the multiple engine ingestion events is unknown. Twenty-one of the remaining 23 events occurred in the foreign environment, yielding a foreign ingestion rate of 0.119 ingestions per 10,000 operations. The United States rate is 0.021 ingestions per 10,000 operations. The foreign multiple engine ingestion rate is 5.8 times greater than the United States rate.

For comparison, the foreign rate at the end of the first year was 0.116 ingestions per 10,000 operations while the United States rate was 0.047. This indicates that the foreign multiple engine ingestion rate has remained relatively constant over the 2 years of this study. The United States multiple engine ingestion rate has been halved from the first to the second year because no United States multiple engine ingestions have been reported during the second year of this study. This comparison of the United States versus foreign multiple engine ingestion rates for 26 months, further suggests that the United States and foreign bird environments are not the same.

3.4 AIRPORT BIRD INGESTION EXPERIENCE.

With the exception of those events where the geographic bird ingestion location is unknown, all remaining ingestions occurred in the airport environment. "Environment" in this case may be defined as the airport and the airspace immediately above and adjacent to it. Over 76 percent of all known bird ingestions occur during the combined takeoff and landing phases-of-flight. These phases-of-flight occur mostly within the geographical confines of the airport.

TABLE 3.9 AIRCRAFT BIRD INGESTION RATES UTILIZING ONLY KNOWN
BIRD INGESTION LOCATION DATA

	<u>Aircraft Type</u>			
	<u>DC10</u>	<u>A300</u>	<u>B747</u>	<u>L1011</u>
Airports Served	114	101	110	88
Operations	526,256	415,694	704,785	378,090
Ingestions	71	103	194	55
Rate/10K Ops	1.35	2.48	2.75	1.46
Airports Served Where Ingestion Occurred	47	45	72	32
Operations	338,642	237,570	616,954	239,160
Ingestions	71	103	194	55
Rate/10K Ops	2.10	4.34	3.14	2.30

TABLE 3.10 AIRCRAFT BIRD INGESTION RATES UTILIZING COMBINED KNOWN AND
UNKNOWN BIRD INGESTION LOCATION DATA

	<u>Aircraft Type</u>			
	<u>DC10</u>	<u>A300</u>	<u>B747</u>	<u>L1011</u>
Airports Served	114	101	110	88
Operations	526,256	415,694	704,785	378,090
Ingestions	97	144	297	91
Rate/10K Ops	1.84	3.46	4.21	2.41
Airports Served Where Ingestion Occurred	47	45	72	32
Operation	338,642	237,570	616,954	239,160
Ingestions	97	144	297	91
Rate/10K Ops	2.86	6.06	4.81	3.81

Over 90 percent of the bird ingestions which occurred during the course of this study, for which the altitudes are known, occurred below 3000 feet. Most engine bird ingestions are encountered when the aircraft is relatively close to, if not on, the ground. Consequently, the bird ingestion phenomenon suggests an airport environment problem, at least for the aircraft types investigated during the course of this study. The phases-of-flight in which the bird ingestion events occurred are graphically depicted in figure 3.7. The phase-of-flight data used to generate this figure are those data reported by the operator of the aircraft. It is recognized that phase-of-flight definitions vary considerably in the industry, however, the data are a compilation from many operators and it is assumed that normal data scatter would tend to mitigate any bias in phase-of-flight definitions.

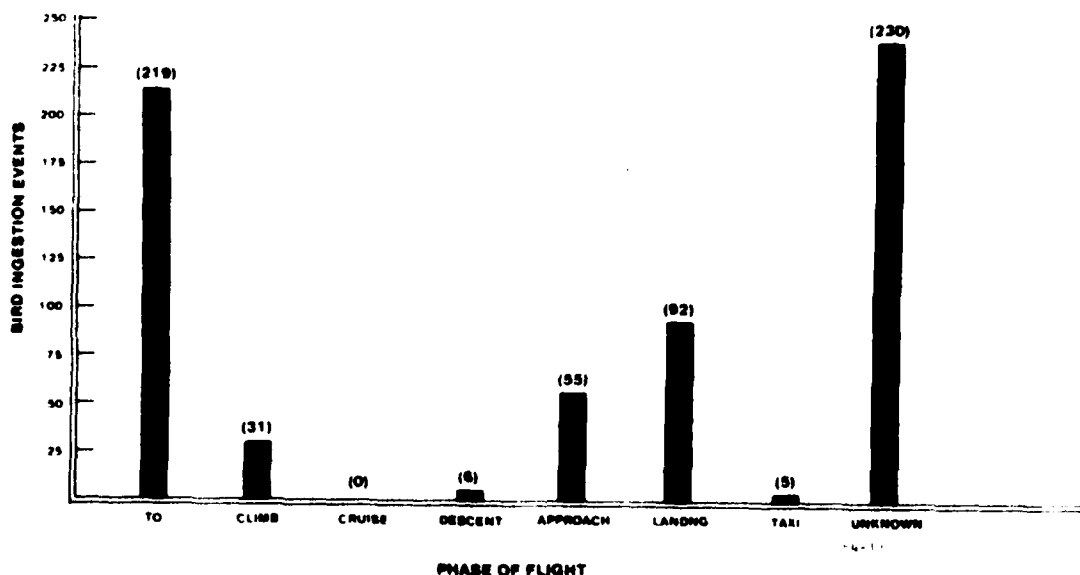
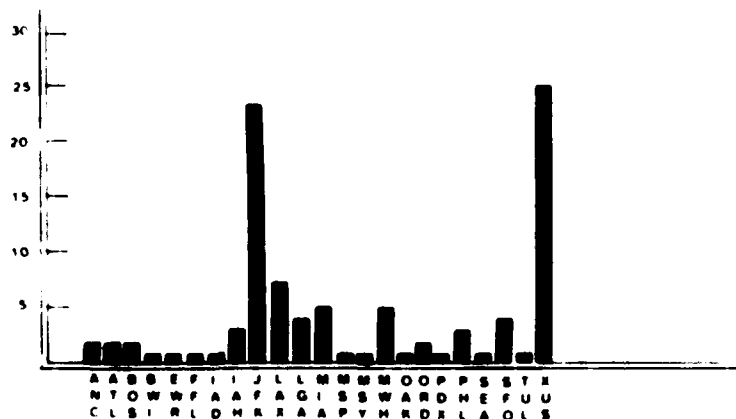


FIGURE 3.7 PHASE-OF-FLIGHT VERSUS NUMBER OF BIRD INGESTION EVENTS

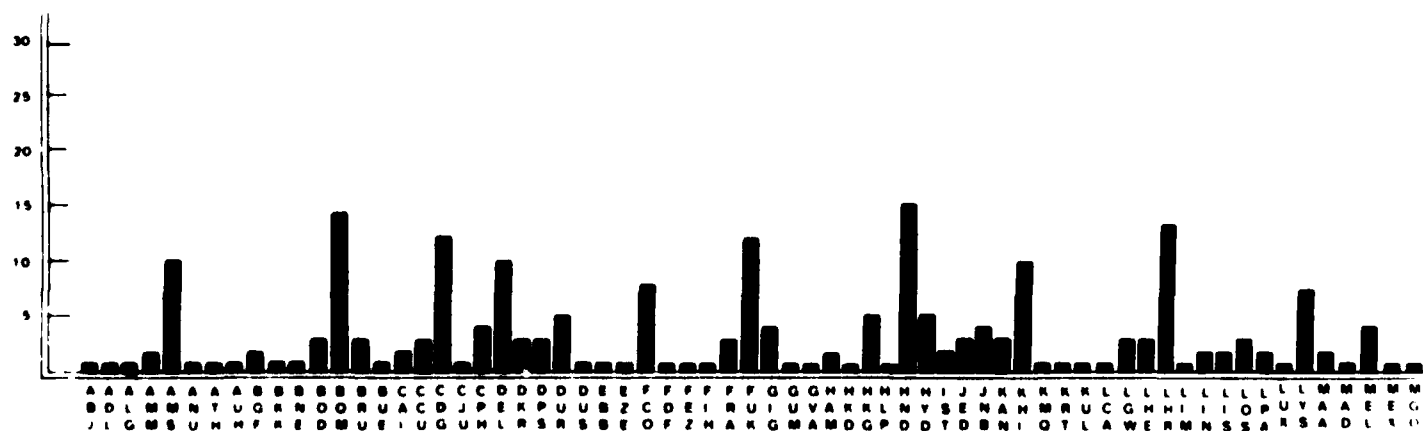
From the OAG tapes it was determined that approximately 429 airports worldwide accommodated the eight aircraft types studied. Sixty-two of these airports are located in the United States and 367 are in foreign locations. During the course of this study, engine bird ingestions were experienced at 22 known United States airport locations and 115 known foreign airport locations. Figure 3.8 lists these airports along with the number of ingestion events which occurred at each location. The acronym identifiers for these 137 airports are listed in appendix G. It should be noted that airport identifiers XUS and XFO denote bird ingestions in United States and foreign locations, respectively; however, the exact airport where the ingestion occurred is not known. In addition, the bird ingestion data base

U.S. INGESTIONS



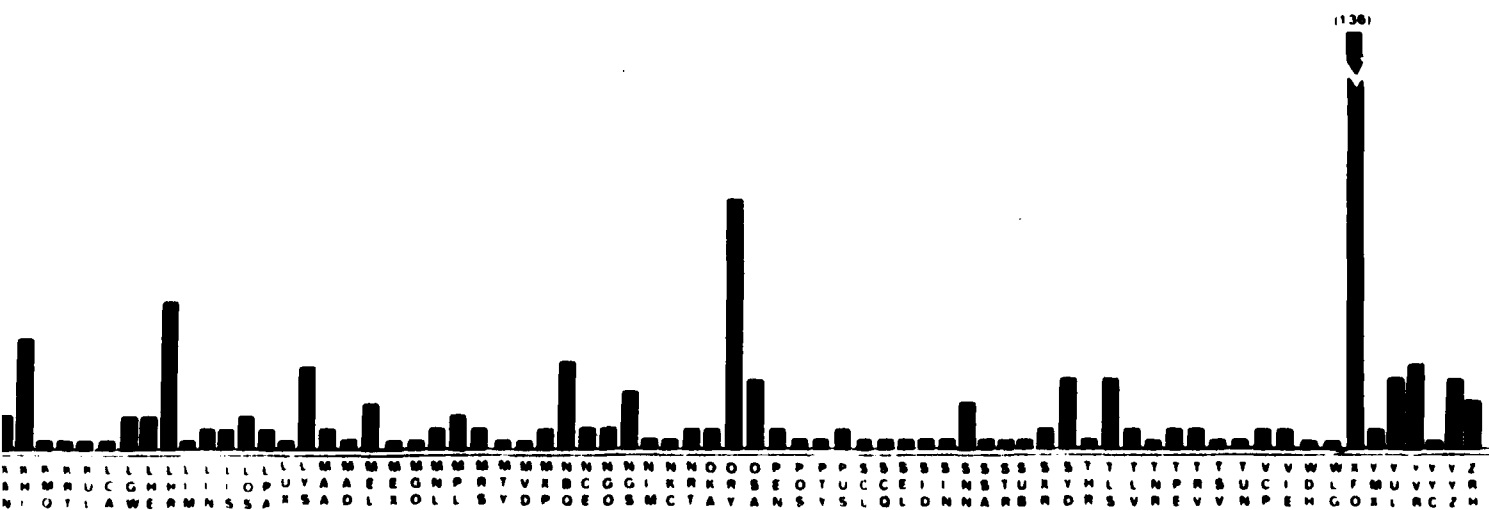
U.S. AIRPORTS

FOREIGN INGESTIONS



FOREIGN AIRPORTS

FIGURE 3.8 BIRD INGESTION FREQUENCY



IGN AIRPORTS

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2 3.8 BIRD INGESTION FREQUENCY VERSUS AIRPORTS

(appendix E) lists an airport identifier XXX which denotes that the bird ingestion occurred at a totally unknown location. Often it is known that a bird ingestion has taken place as evidenced by preflight and postflight inspections of the engines or during an engine teardown for maintenance. In most of these cases the exact geographic ingestion location is unknown. It is possible, in many cases, to determine whether the ingestion occurred in the United States or in a foreign location by extrapolating the known data such as operations between United States or foreign city pairs and operator route structures. Utilizing this technique, it was possible to broadly identify the United States or foreign ingestion location for 161 of the 208 unknown ingestion locations. The remaining 47 events occurred at an unknown location (XXX). Table 3.11 lists the geographic distribution of engine bird ingestion events, including the general locations XUS and XFO.

TABLE 3.11 GEOGRAPHIC DISTRIBUTION OF BIRD INGESTION EVENTS

	<u>U.S.</u>	<u>Foreign</u>	<u>Worldwide</u>
Known Location Ingestions	72	358	----
Extrapolated Location Ingestions	25 (XUS)	136 (XFO)	----
Unknown Location Ingestions	----	----	47 (XXX)
Total Ingestions	97	494	638

The geographic distribution of the 430 bird ingestion events where geographic location is known are shown on the world map, figure 3.9.

As previously stated, the 638 engine bird ingestion events which have been reported during this study have occurred at 137 airports around the world. This yields a worldwide airport bird ingestion event rate of 4.65 bird ingestion events per airport. All airports which experienced 5 or more bird ingestion events during the course of this study were examined. Results are presented in table 3.12. Analysis of the data contained in this table shows that 25 airports account for 36.5 percent of all worldwide bird ingestion events for the aircraft types studied. In addition, most of these airports are located in 5 distinct geographic areas of the world — the interior of the Indian subcontinent, extreme Western Europe (including England), the United States east coast (including the Canadian Great Lakes Region), the United States and Canadian West Coast, and the islands of Japan. Figure 3.9 depicts these locations as well as other, less frequent bird ingestion locations. Appendix H lists all airports including bird ingestion events, operations, and ingestion rates by aircraft type.

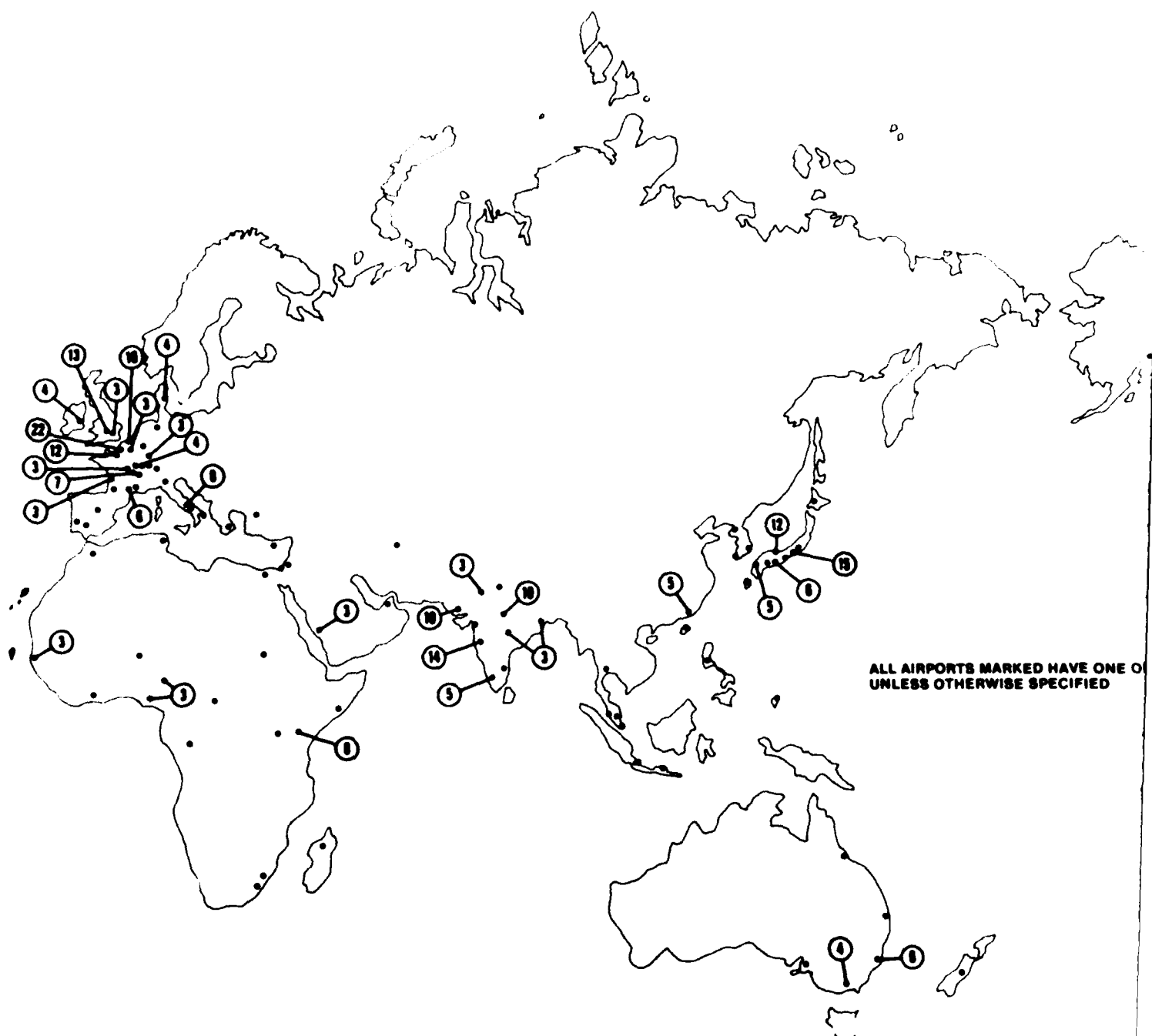
In addition, appendix H lists 19 airports which have experienced multiple engine ingestions. Twenty-five such events occurred (22 two-engine events and three three-engine events). Four of the multiple-engine ingestions resulted in at least one of the engines failing. In one of these cases, two engines failed on a four-engined aircraft during the approach phase of the flight. This was the only

TABLE 3.12 AIRPORT BIRD INGESTION RATES

(5 Or More Ingestions)

<u>Airport</u>	<u>Operations</u>	<u>Ingestions</u>	<u>Rate/10K Ops</u>	<u>Rank</u>
LYS	3863	7	18.12	1
TLS	3573	6	16.79	2
HYD	3232	5	15.47	3
NBO	7767	8	10.30	4
DUR	5739	5	8.71	5
NGS	5861	5	8.53	6
YUL	7041	6	8.52	7
YVR	9266	7	7.55	8
KHI	17013	10	5.88	9
DEL	17190	10	5.82	10
AMS	17279	10	5.79	11
BOM	26062	14	5.37	12
FUK	22698	12	5.28	13
ORY	41689	22	5.28	14
PCO	27501	8	2.91	15
CDG	47054	12	2.55	16
YYZ	24982	6	2.40	17
HND	65874	15	2.28	18
SYD	27631	6	2.17	19
LHR	64731	13	2.01	20
JFK	116769	23	1.97	21
MW	39167	5	1.28	22
OSA	55474	6	1.08	23
MIA	64913	5	0.72	24
LAX	103027	7	0.68	25

NOTE: See appendix G for airport identifiers.



two-engine failure determined during this study. None of the three-engine ingestion events resulted in an engine failure. A summary of the multiple engine ingestion events are presented in table 3.13.

TABLE 3.13 MULTIPLE ENGINE INGESTION EVENTS

<u>Airport</u>	<u>Aircraft Type</u>	<u>Engines Involved</u>	<u>Phase Of Flight</u>	<u>No. Of Birds</u>	<u>Bird Weight (oz.)</u>
AMS	B747	3	Takeoff	-, -, 2	8 oz.
BOD	A300	2	Takeoff	1, 1	32 oz.
BWI	DC10	2	Landing	-, -	- oz.
CPH	D747	2	Approach	1, 2	16 oz.
CPH	DC10	2*	Takeoff	1, 2	14 oz.
DPS	B747	2	Takeoff	-, -	- oz.
EBB	DC10	2	Takeoff	1, 2	40 oz.
EZE	B747	2	Takeoff	3, 4	13 oz.
HND	DC10	2	Approach	-, -	20 oz.
JED	B747	2**	Approach	-, -	11 oz.
KAN	DC10	2	Landing	-, -	- oz.
KHI	B747	2	Takeoff	1, 1	40 oz.
LHE	A300	2	Landing	1, 1	32 oz.
LHR	L1011	2	Takeoff	1, 1	10 oz.
LHR	B747	3	Landing	-, -, -	- oz.
MEL	A300	2	Takeoff	1, 1	24 oz.
MEL	B747	2*	Climb	5, 4	20 oz.
MWH	B747	2	Approach	1, 1	80 oz.
ORY	A300	2	Takeoff	2, 2	11 oz.
ORY	B747	2	Takeoff	1, 1	10 oz.
SYD	B747	3	Takeoff	2, 2, 2	11 oz.
YVR	B747	2	Landing	-, -	- oz.
ZRH	B747	2*	Takeoff	6, 3	13 oz.
XXX	DC10	2	Unknown	-, -	- oz.
XXX	B747	2	Unknown	1, 3	9 oz.

- (*) Represents One Engine Failed
- (**) Represents Two Engines Failed
- (XXX) Unknown Location
- (-) Unknown

The location of airports within the aforementioned geographic areas, as well as other areas of the world, often determines the magnitude of the bird ingestion problem which the airports experience. Often they are located in bird flyways or along bird migration routes. The vast open areas of airports are a natural resting place for the birds in these situations. Although it was not a specific objective of this study to determine why birds often prefer to inhabit the airport environment, the reports of the engine manufacturers (PWA, GE, RR) in many cases contained

great detail with regard to the airport environment where a particular bird ingestion had taken place. Such factors as the grass height, availability of food, proximity to bodies of water, number of aircraft operations, number of runways, and other factors often determine not only the quantity of birds present on the airport, but the type of bird as well. Many airports have instituted bird control programs with varying degrees of success. On the surface it appears that such programs must be tailored to the particular needs of each airport.

A summary of the information contained in this airport section is presented in table 3.14.

TABLE 3.14 SUMMARY OF AIRPORT INGESTION EVENTS

	<u>Aircraft Types</u>						
	<u>DC10</u>	<u>A300</u>	<u>B747</u>	<u>B757</u>	<u>B767</u>	<u>L1011</u>	<u>Total</u>
<u>Known Airport Locations</u>							
Operations	526,256	415,694	704,785	3,384	13,162	378,090	2,041,371
Events	71	103	194	1	3	55	427
Rates/10K Ops	1.35	2.48	2.75	2.96	2.28	1.45	2.09
<u>World</u>							
Operations	692,616	516,246	883,150	6,400	25,138	589,000	2,712,550
Events	97	144	297	1	4	91	634
Rates/10K Ops	1.40	2.79	3.36	1.56	1.59	1.54	2.34
<u>Percent of Worldwide Operations at Known Airport Locations</u>							
	76.0	80.5	79.8	52.9	52.4	64.2	75.4

NOTE: Airport statistics are based on 137 airports identified in appendix E. The the events for Unknown United States (XUS), Unknown Foreign (XFO), and Unknown locations (XXX), are excluded from known airport location statistics. For the DC8 and A310 aircraft, data by airports is not available.

3.5 ENGINE DAMAGE AND FAILURE DESCRIPTION.

Damage assessment was determined by utilizing the engine manufacturers' written reports, photographs of individual bird ingestion events, and detailed review of the evidence by FAA Technical Center personnel. The engines experienced 666 ingestions during the 26 months of this study. Sixty-two percent (416) of these engines experienced some degree of damage. For the purposes of this study, nine generalized engine damage categories were defined. FAA Technical Center

personnel reviewed each of the 666 engine ingestions and characterized the damage according to the nine generalized categories. The results of this detailed technical damage assessment for each engine ingestion are tabulated in appendix E. The nine generalized damage categories, coded 1 through 9, are:

1. N/A - No damage.
2. Bent - One to 10 fan blades bent (minor damage).
3. Bent Many - More than 10 fan blades bent.
4. Broken - Broken fan blade(s), leading edge and/or tip pieces missing, other blades also bent.
5. Transverse Fracture - A fan blade broken chordwise (across) and the piece is missing (includes secondary hard object damage).
6. Spinner - Dented, broken, or cracked spinner (includes spinner cap).
7. Core - Bent/broken compressor blades/vanes, blade/vane clash, blocked/disrupted airflow in low, intermediate, and high pressure compressors.
8. Nacelle - Dents and/or punctures to the engine enclosure (includes cowl).
9. Other - Any damage not previously listed.

Most of the above damage categories are pictorially represented in appendix I.

Figure 3.10 depicts the damage categories for all 666 engines which experienced a bird ingestion. As can be seen, category 1 (no damage) and category 2 (minor damage) comprise the majority of the entries (over 60 percent).

Figure 3.10 also depicts the damage sustained by those engines which are considered to have failed. During the course of this study, an engine failure was defined as the engine's inability to attain and/or maintain approximately 50 percent thrust. The ability of the engine to achieve this level of power was based upon the engineering judgment of a combined group of U.S. Government aerospace propulsion engineers. Their assessment of engine failure was based upon photographic evidence, extent of fan and/or core damage, transverse fracture of a fan blade, phase-of-flight, engine action and pilot reaction, in-flight engine data, and personal interviews (by the contractor) with the pilot. All of these criteria were not always available. Neither this report nor the evidence gathered during this study is intended to define the failure mechanism of these engines. However, it can be stated that each failure mode is unique and complex. No attempts were made to compare the relative merits or shortcomings among the engine models, or for that matter, the aircraft types. Examination of figure 3.10 shows that engines which fail (and many which do not fail) tend to have multiple damage categories associated with them. This is evidenced by the fact that 32 engines were considered to have failed, however, the damage associated with these engines appears 103 times (filled-in circles figure 3.10). This is expected, due to the secondary hard object damage which the engine can experience after a severely damaging bird ingestion. In these cases, typically, a bird ingestion may cause a stage 1 fan blade fracture (or spinner failure) which, in turn, releases hard objects such as pieces of blade (or spinner material). These hard objects are reingested into the fan and/or core engine which causes secondary damage. For example, an engine which experiences a severely damaging ingestion may suffer a transverse blade fracture (category 5) which releases a metal blade piece. This piece is reingested into the fan causing other blades to break (category 4) and bending still other blades (category 3), damaging the nacelle with the loose fragments (category 8). Finally, these fragments may be ingested into the core engine (category 7). In many cases

FIGURE 3.10 BIRD INGESTION DAMAGE CODES

where the engine failed, such a scenario is common. It must be reemphasized, however, that an engine failure is the exception rather than the norm.

Figure 3.11 shows that of the 666 engines which experienced a bird ingestion, information was available with regard to the weight and number of birds ingested in 335 cases. Additionally, of the 32 engine failures, information regarding the weight and number of birds ingested was available in 30 cases. Figure 3.11 presents these data and shows that approximately 81 percent of the bird ingestions involve only one bird, with a corresponding failure rate in that category of 5.9 percent (16 engine failures, 272 ingestions). The 19 percent of the ingestions which involve more than one bird have a corresponding failure rate of 22 percent.

The preceding discussion points out a pertinent observation. Namely, the engine failure rate for single bird ingestions ($0.81 \times 0.059 = 0.048$) and multiple bird ingestions ($0.19 \times 0.22 = 0.042$) are almost identical and compare favorably with the worldwide bird ingestion engine failure rate of 4.8 percent (32 engine failures, 666 ingestions). Therefore, with regard to the numbers of birds ingested, the data indicate that once the ingestion has occurred, be it a single bird or multiple birds, the probability of experiencing an engine failure is approximately 5 percent in either case.

With regard to the weights of these birds, figure 3.11 shows that birds of 8 ounces or less do not generally cause HBPR engines to fail. Examination of appendix E for this weight category also reveals that, primarily, minor or no damage is incurred. Half of the bird ingestions and engine failures occurred between 9 and 24 ounces ($>1/2$ to $1\ 1/2$ pounds). Examining the weight interval, 0 to 24 ounces, and comparing the engine failures against ingestions, yields a failure rate of 7.8 percent (217 ingestions versus 17 failures). Likewise, the weight interval, 25 to 48 ounces, produces a rate of 7.2 percent (97 ingestions versus 7 failures). However, the weight interval 49 ounces and greater, produces a failure rate of 28.6 percent (21 ingestions versus 6 failures) which indicates that once the bird weight exceeds a certain value (in this case, 3 pounds) experiencing an engine failure becomes more probable.

Attempts have been made to determine the association among engine failures, phase-of-flight, number of birds, and bird weight. (It should be noted that 22 engine failures out of 32, occurred at takeoff and 5 engine failures occurred during the climb phase-of-flight. These two phases-of-flight account for 84 percent of the engine failures.) The results of these attempts have been inconclusive because insufficient data exists to allow an indepth analysis. However, an analysis was conducted which sought to determine the association between bird weight and number of birds for engines which failed and also for engines which did not fail. Tables 3.15 and 3.16 are each 2×3 contingency tables which show the data of figure 3.11 condensed for analysis purposes. Note that the weight categories (1 to 24, 25 to 48, > 49) and the numbers of birds (1, >1) are the same as the previous analysis.

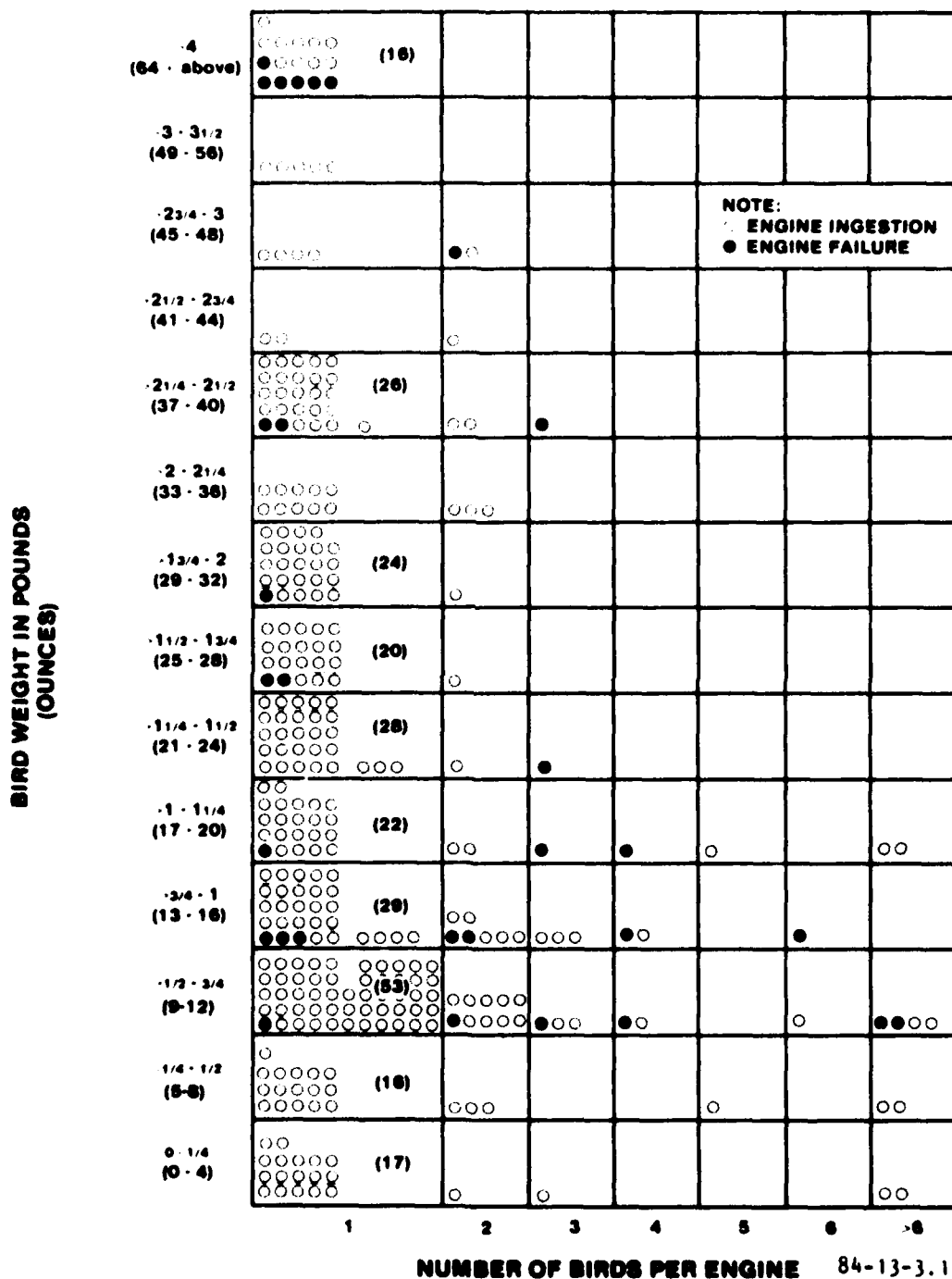


FIGURE 3.11 BIRD WEIGHT, NUMBER PER INGESTION AND ENGINE FAILURE DISTRIBUTION

TABLE 3.15 ENGINE FAILURE FREQUENCIES BY BIRD WEIGHT AND NUMBER OF BIRDS

<u>Number of Birds</u>	<u>Bird Weight</u>			Total
	1-24 ounces	25-48 ounces	>49 ounces	
1	5	5	6	16
>1	12	2	0	14
Total	17	7	6	30

TABLE 3.16 NON-FAILED ENGINE FREQUENCIES BY BIRD WEIGHT AND NUMBER OF BIRDS

<u>Number of Birds</u>	<u>Bird Weight</u>			Total
	1-24 ounces	25-48 ounces	>49 ounces	
1	160	81	15	256
>1	40	9	0	49
Total	200	90	15	305

The Test of Association of Contingency Tables (appendix C) was used to determine whether a strong association exists between bird weight and number. It yielded a value of 10.08 for table 3.15 data and a value of 6.83 for table 3.16 data. Both values are chi-square distributed with 2 degrees-of-freedom. Both values are significant at the 95 percent confidence level and negate the assertion that the two factors, bird weight and number of birds, are independent. The measure of association between these two factors for the data of tables 3.15 and 3.16 are 0.502 and 0.149, respectively. (Values close to zero indicate lack of association between the row and column factors of the contingency table, whereas, values closer to 1.0 indicate strong association.) The association measure for engines which failed is relatively stronger than the measure obtained for engines which did not fail. Although, this analysis establishes association between the two factors, it does not indicate that engine failures are predictable based on the knowledge of number of birds and their weight. The underlying reasoning for this inference arises from the fact that the chi-square values imputed in the data of tables 3.15 and 3.16, 10.08 and 6.83, respectively, exhibit no significant differences in their magnitudes to suggest that the underlying distribution of these two samples are drastically different. The test to determine whether these two chi-square values come from different distributions shows, at the 95 percent confidence level, that there is no difference in the underlying distributions in the data of tables 3.15 and 3.16. This supports the inference that association between the two factors cited, namely bird weight and bird number, does not provide, by itself, the basis for predicting an engine failure as a function of bird weight and number of birds.

3.6 PROBABILITY ESTIMATES OF BIRD INGESTION RELATED EVENTS.

The bird ingestion data which has been collected during the 2 years of this study are well suited to the discussion of probabilities. As has been stated, one of the reasons this study was continued into a second year was in order to verify bird ingestion trends which were observed during the first year. In many areas, such as geographic ingestion distribution, total ingestion events, weight distribution, multiple engine ingestions, and others, the repeatability between first and second year data was very good. The following discussion addresses certain of these areas.

3.6.1 Probability of Ingestion of One or More Birds of A Given Weight Range. Table 3.17 gives the frequency of single and multiple bird ingestion events by bird weight. The probability estimate of ingesting one or more birds of a given weight range can be obtained by dividing the total number of events in that weight range by the total number of bird ingestion events. For example, the probability of ingesting one or more birds in the 1- to 8-ounce weight range is calculated by: $43/335 = 0.128$. The remaining weight range probabilities are calculated in a similar fashion.

TABLE 3.17 INGESTION PROBABILITIES OF SINGLE AND MULTIPLE BIRDS BY WEIGHT CATEGORY

	Bird Weight							
	1-8 ozs.	9-16 ozs.	17-24 ozs.	25-32 ozs.	33-40 ozs.	41-48 ozs.	49-56 ozs.	>56 ozs.
Single Bird	33	82	50	44	36	6	5	16
Multiple Bird	10	33	9	2	6	3	0	0
Total	43	115	59	46	42	9	5	16
Conditional Probability	0.128	0.3-3	0.176	0.137	0.125	0.027	0.015	0.048
Unconditional Probability	30×10^{-6}	80×10^{-6}	41×10^{-6}	32×10^{-6}	29×10^{-6}	6.3×10^{-6}	3.5×10^{-6}	11×10^{-6}

The calculated probability is conditional. The condition being that an ingestion has taken place. The unconditional probability is obtained by multiplying the conditional probability estimate by the worldwide ingestion occurrence probability of 2.33×10^{-4} (638 ingestions/2,738,382 operations). Therefore, the unconditional probability of ingesting one or more birds in the 1- to 8-ounce weight range is $0.128 \times (2.33 \times 10^{-4}) = 30 \times 10^{-6}$. In other words, this data indicates that for every one million HBPR aircraft operations, it is expected that 30 bird ingestions of single or multiple birds in the 1- to 8-ounce weight range will occur.

3.6.2 Probability of Ingestion of Multiple Birds Per Engine. The data show that 65 engines have experienced an ingestion of more than one bird (multiple birds per ingestion). It is known that a total of 666 engines experienced a bird ingestion. The conditional probability estimate of experiencing a multiple birds per engine ingestion is therefore 0.098 (65 multiple bird ingestions/666 engine ingestions). The unconditional probability estimate of such an event occurring is 22.7×10^{-6} or about 23 multiple bird ingestions per one million operations.

3.6.3 Probability of Multiple Engine Ingestions. Twenty-five multiple engine ingestion events occurred during this study. The conditional probability estimate of such an event occurring is 0.039 (25 multiple engine ingestion events/638 ingestion events). The unconditional probability estimate is approximately 9×10^{-6} or nine multiple engine ingestion events per million operations.

4. SUMMARY.

The purpose of this investigation was to determine the numbers, weights, and species of birds which are being ingested into large high bypass ratio (HBPR) turbine aircraft engines during service operation and determine what damage, if any, resulted. To meet this objective, the FAA Technical Center and three engine contractors — Pratt and Whitney Aircraft, General Electric Company, and Rolls-Royce Incorporated — gathered worldwide bird ingestion data.

During the course of this study, 1513 HBPR engined aircraft conducted 2.7 million operations and were involved in 638 bird ingestion events. The first and second year's bird ingestion distributions were compared. It was determined that their distributions were statistically similar, therefore, no further data was collected.

The United States and foreign bird environments were compared. This comparison suggested that the bird weight distribution differed in these two environments. A comparison of the single and multiple engine bird ingestion rates was conducted. Both foreign rates were significantly higher than the U.S. rates. Finally, the average, most likely, and median bird weights were compared. In all three instances, the U.S. bird weights were higher than the foreign bird weights.

Worldwide, gulls (family Laridae) were ingested most often. The following selected bird species (for 5 or more ingestions) are presented in decreasing order of ingestion frequency on a worldwide basis:

1. *Milvus migrans* (Black Kite) - 46 ingestions
2. *Larus ridibundus* (Common Black-headed Gull) - 34 ingestions
3. *Larus argentatus* (Herring Gull) - 27 ingestions
4. *Columba palumbus* (Wood Pigeon) - 23 ingestions
5. *Larus crassirostris* (Black-tailed Gull) - 14 ingestions
6. *Larus delawarensis* (Ring-billed Gull) - 11 ingestions
7. *Vanellus vanellus* (Common Lapwing) - 10 ingestions
8. *Anas platyrhynchos* (Mallard Duck) - 9 ingestions
9. *Columba livia* (Common Rock Dove) - 8 ingestions
10. *Tyto alba* (Common Barn Owl) - 6 ingestions
11. *Corvus corone* (Carrion Crow) - 6 ingestions
12. *Larus atricilla* (Laughing Gull) - 5 ingestions
13. *Larus novaehollandiae* (Silver Gull) - 5 ingestions
14. *Francolinus francolinus* (Francolin) - 5 ingestions

The overwhelming majority of the 85 species of birds identified by this study are flocking or grouping birds. Bird flocks are the greatest hazard to aircraft and are responsible for almost all multiple engine ingestions.

In most cases, the bird debris was identified by an ornithologist who determined weights and species.

Seasonal changes appear to have an effect on the bird ingestion rate. The largest number of bird ingestions occurred during the late summer and early fall.

A comparison of the ingestion rates according to generic aircraft type was conducted. Analysis revealed that the center engine position of the three-engined aircraft experienced significantly lower bird ingestions than the wing-mounted engines. From a bird ingestion standpoint, the center engine position may be considered to be practically non-existent. Analysis indicates that an aircraft with four wing-mounted engines may be expected to have approximately twice the ingestion rate of aircraft with only two wing-mounted engines.

Seventy-six percent of bird ingestion occur during the takeoff and landing phase-of-flight. Most bird ingestions occur at the airport when the aircraft is close to, or on, the ground. Twenty-two United States and 115 foreign airports experienced bird ingestions during this study. Some airports present a greater bird ingestion hazard than others as indicated by the analysis that 18 percent (25) of these airports account for almost 36 percent of all reported worldwide bird ingestions for the aircraft types studied. This suggests that the bird ingestion phenomenon is primarily airport environment dependent.

Sixty-two percent of bird ingestions resulted in some engine damage, both minor and major. However, the vast majority of bird ingestions caused minor damage to the engine. Usually, only a small number of fan blades need replacement (minor damage). But in severely damaging bird ingestion events, the damage includes broken fan blades, transversely fractured fan blades, spinner damage, core engine damage, fan shroud and nacelle damage.

The 638 aircraft bird ingestion events involved 666 engines. Twenty-five multiple engine ingestions occurred; three of these involved three engines. Sixty-five multiple bird ingestions per engine occurred. Thirty-two engine failures were identified. Of these thirty-two engine failures, one incident occurred involving a two-engine failure to a four-engine aircraft during the approach phase-of-flight.

The majority of bird ingestions, engine damage, and engine failures are caused by birds weighing between 9 and 24 ounces. Although there appears to be a correlation between the number and weight of the ingested birds, it is not possible to predict engine failure based upon these two parameters alone.

Tables 4.1 and 4.2 review some of the relationships presented in this report. It should be noted that the takeoff and climb phases-of-flight produces the highest percentages in all ingestion categories. Although approach and landing constitute a significant portion (36 percent) of all known phases-of-flight, the percentages of damaging ingestions and engine failure ingestions are significantly lower than in takeoff and climb. Multiple birds per engine occur in a significantly high percentage of engine failure ingestions. Multiple engine ingestions do not produce significant percentages in any ingestion category.

TABLE 4.1 MULTIPLE ENGINE AND MULTIPLE BIRD INVOLVEMENT ANALYSIS

	Total Ingestion Events (638)	Damaging Ingestion Events (401)	Engine Failure Ingestions (32)
Multiple Engine Ingestion Events	25 (4%)	19 (5%)	4 (13%)
Multiple Bird Ingestions (per engine)	65 (10%)	47 (12%)	14 (44%)

TABLE 4.2 PHASE-OF-FLIGHT (POF) ANALYSIS

	Known POF Ingestion Events (408)	Known POF Damaging Ingestion Events (250)	Known POF Engine Failures (32)
Takeoff and Climb	249 (61%)	215 (86%)	27 (84%)
Approach and Landing	147 (36%)	35 (14%)	4 (12%)

5. CONCLUSIONS.

1. A bird ingestion to a high bypass ratio (HBPR) engined aircraft is a rare, but probable, event. Approximately 2.7 million operations were conducted during the 26 months of this study; 638 bird ingestion events occurred. This results in approximately 25 bird ingestions per month.

2. The most commonly ingested birds worldwide, are the family Laridae (gulls) which account for 35 percent of all ingestions to HBPR engines. These are closely followed by the family Accipitridae (kites) which account for 20 percent of all ingestions.

3. The United States and foreign bird weight distributions are different. United States birds are heavier than birds found in the foreign environment.

4. The United States single and multiple engine bird ingestion rates are lower than the foreign rates.

5. Flocking and grouping birds are the greatest hazard to aircraft and are responsible for almost all multiple engine ingestions.

6. The largest number of bird ingestions occur in the late summer and early fall. Seasonal changes appear to have an effect on the bird ingestion rate.

7. Wing-mounted HBPR engines are more susceptible to bird ingestions than center aft-mounted HBPR engines. Center aft-mounted HBPR engines experience very few bird ingestions.

8. Four-engined aircraft experience approximately twice the ingestion rate of two-engined aircraft (wing-mounted engines only).
9. The majority of bird ingestions resulted in either minor or no damage to the engines.
10. Seventy-six percent of all bird ingestions occur during takeoff or landing.
11. Certain airports present a greater bird ingestion hazard than others. Eighteen percent of the 137 airports which experienced bird ingestions during this study accounted for 36 percent of all reported worldwide bird ingestions for the aircraft type studied.
12. Sixty-two percent of all bird ingestions result in some engine damage.
13. The majority of bird ingestions, engine damaging ingestions, and engine failures are caused by birds weighing between 1/2 pound and 1 1/2 pounds.
14. Once a bird ingestion has occurred, the probability of experiencing an engine failure from one bird or multiple of birds is approximately 5 percent.
15. Engine failure cannot be predicted based upon knowledge of the bird weight and bird number alone. Engine failure modes are complex.
16. Only limited data analysis could be accomplished on the DC8-70 series, A310, B757, and B767, due to their limited service experience.

6. REFERENCES.

1. Frings, G., A Study of Bird Ingestions into Large High Bypass Ratio Turbine Aircraft Engines, DOT/FAA/CT-82/144, Interim Report, March 1983.
2. Edwards, P. E., A Coded List of Birds of the World, Copyright 1974 by Ernest Preston Edwards.
3. Brough, T., Average Weight of Birds, Ministry of Agriculture, Fisheries, and Food; Aviation Bird Unit; Worplesdon Laboratory, Guildford, Surrey, England, 1982.
4. Robbins, C. S., Bruun, B., and Zinn, H. S., Birds of North America, Golden Press, New York, 1966.
5. Siegel, S., Nonparametric Statistics, McGraw-Hill, New York, 1965.
6. Janes All the Worlds Aircraft, Janes Publishing Company Limited, London, England, 1982.
7. United States Department of Transportation, Federal Aviation Administration, Advisory Circular (AC 25.1309-1) September 7, 1982.

APPENDIX A
COMPARISON OF HBPR ENGINE AIRCRAFT

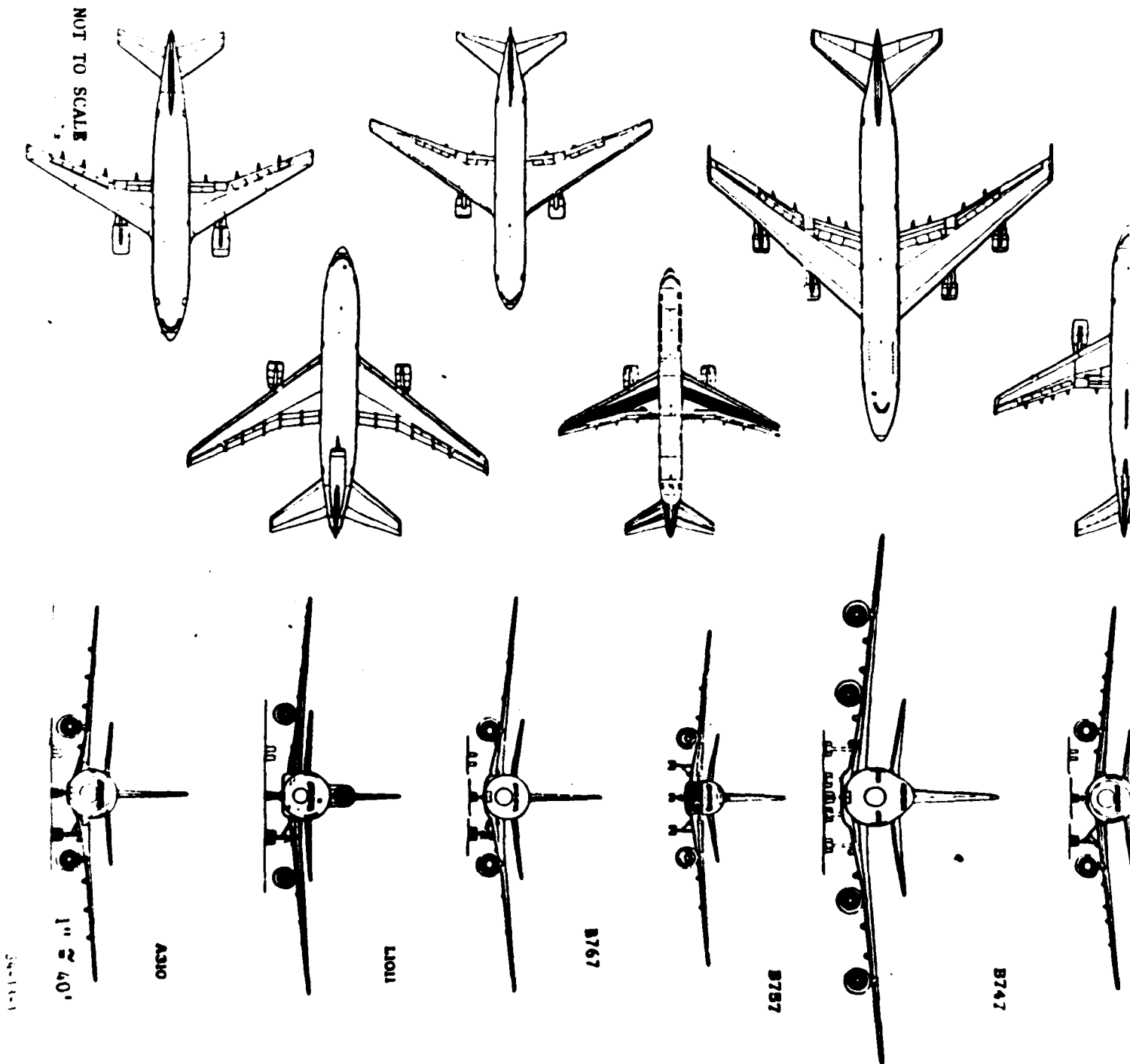


FIGURE A-1. COMPARISON OF HBPR ENGINE AIRCRAFT

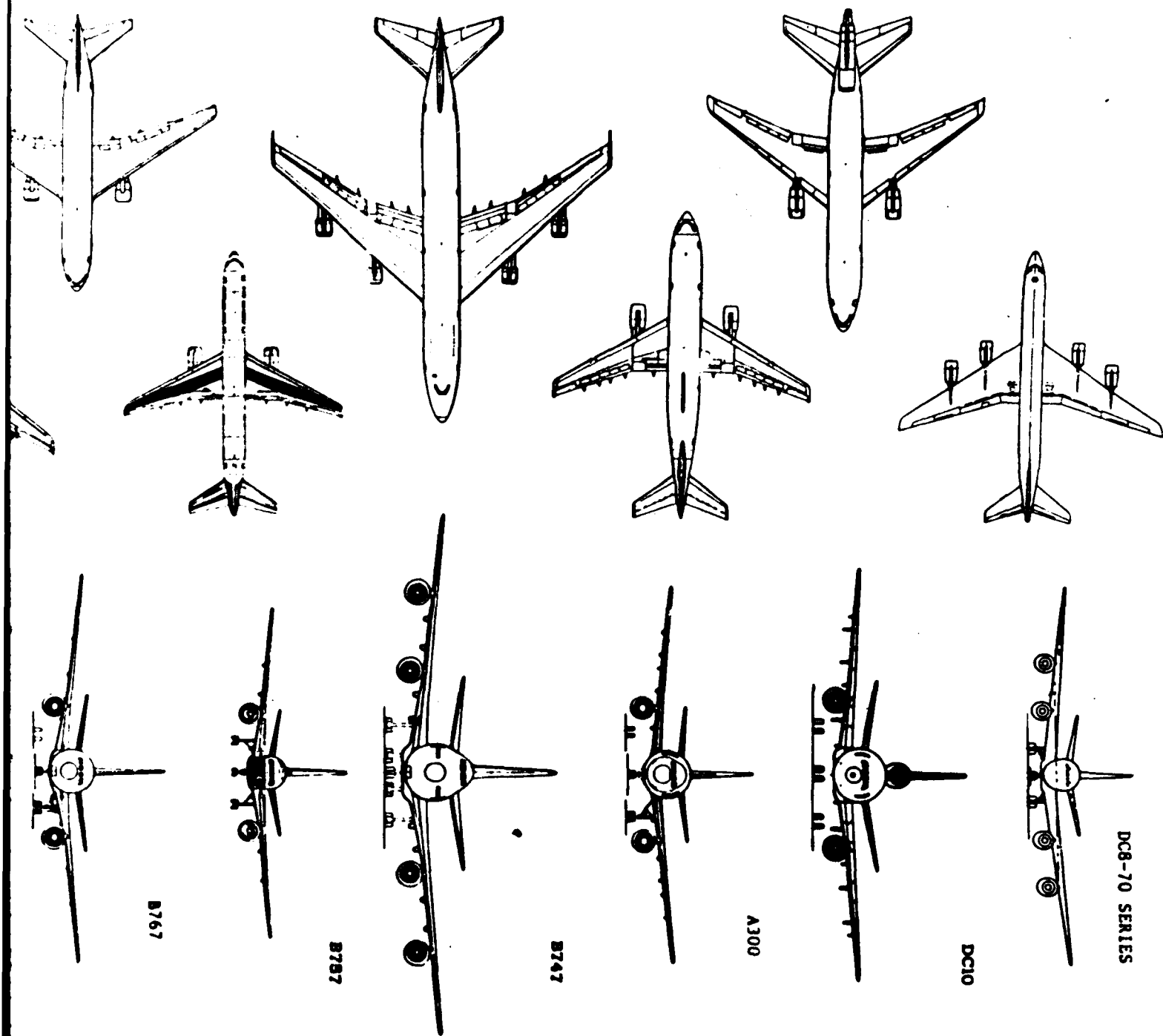
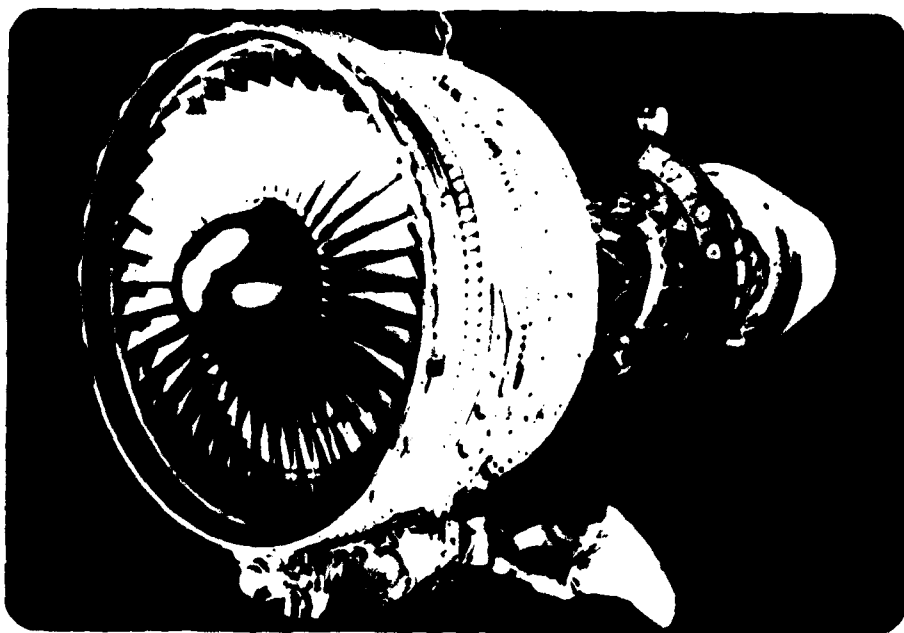


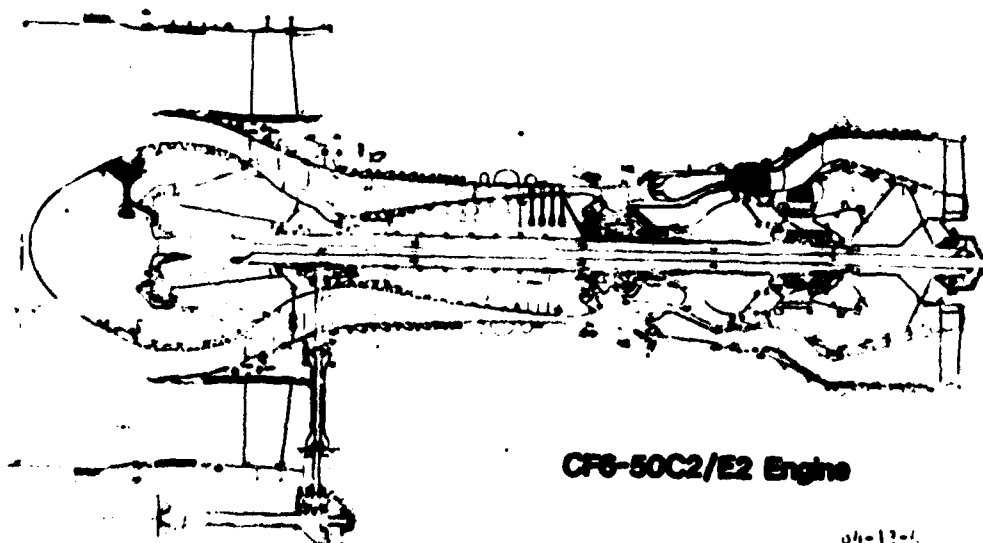
FIGURE A-1. COMPARISON OF HBPR ENGINE AIRCRAFT

APPENDIX B
HBPR ENGINES



GENERAL  ELECTRIC
U.S.A.

CF6-80 High Bypass Turbofan Engine

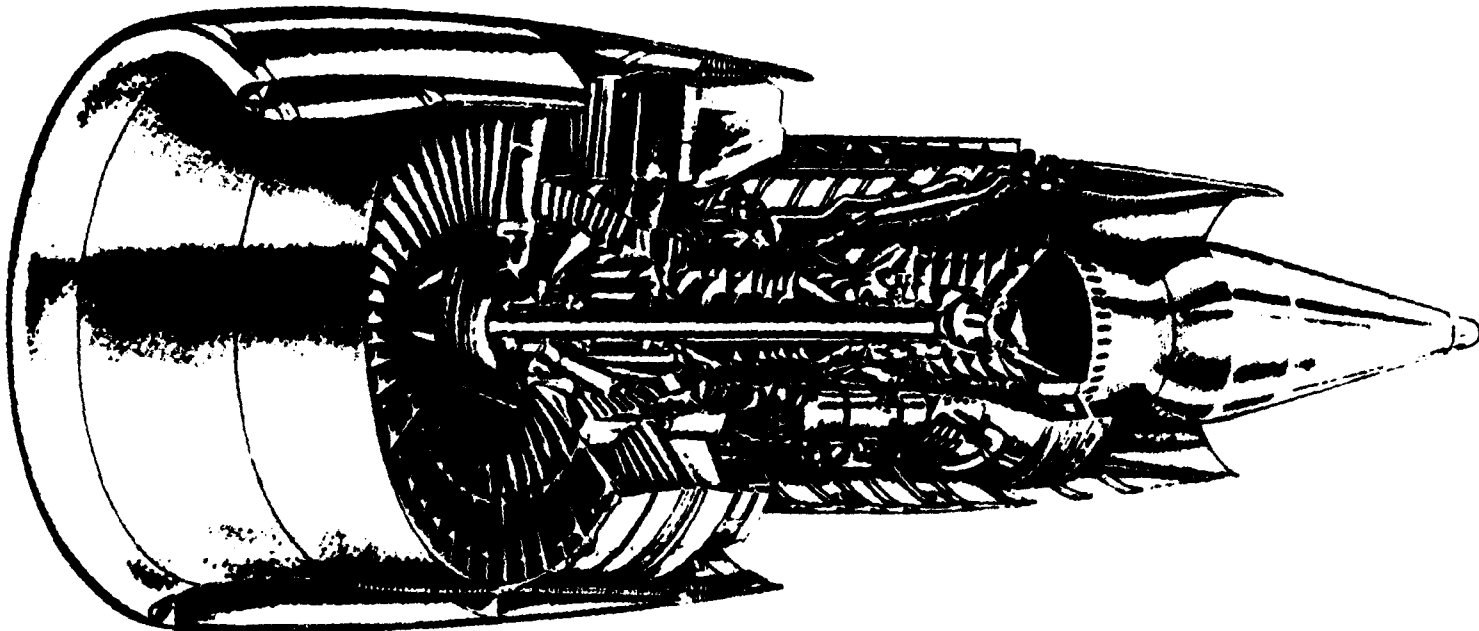


CF6-50C2/E2 Engine

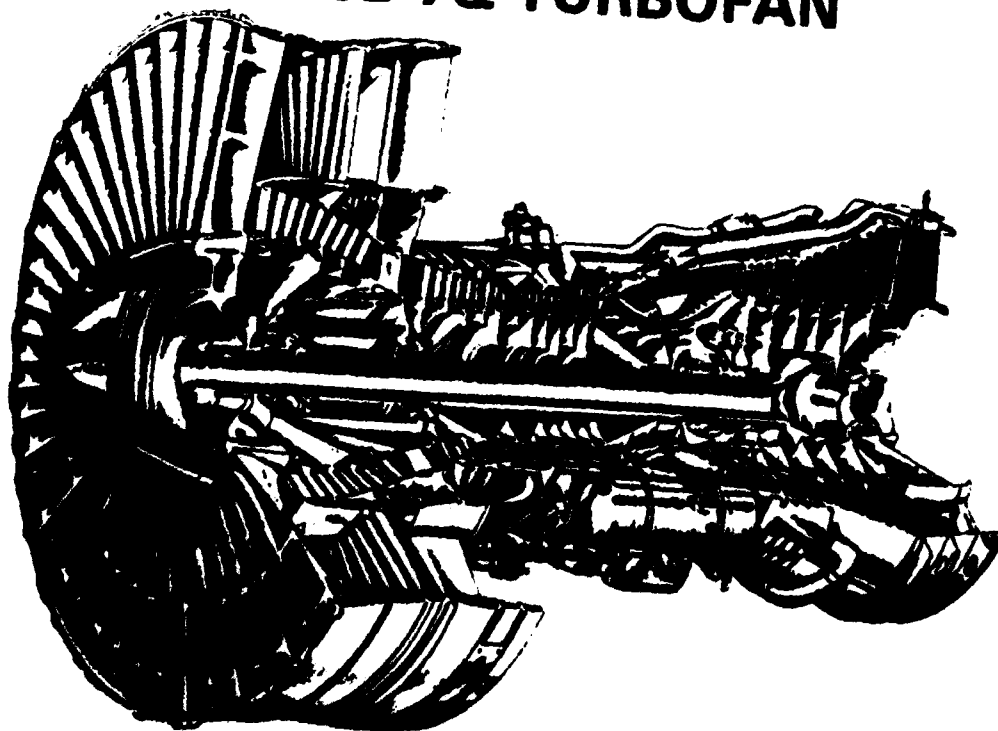
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FIGURE B-4. GE CF6-50 ENGINE

JT9D-7Q/747 PROPULSION SYSTEM



JT9D-7Q TURBOFAN

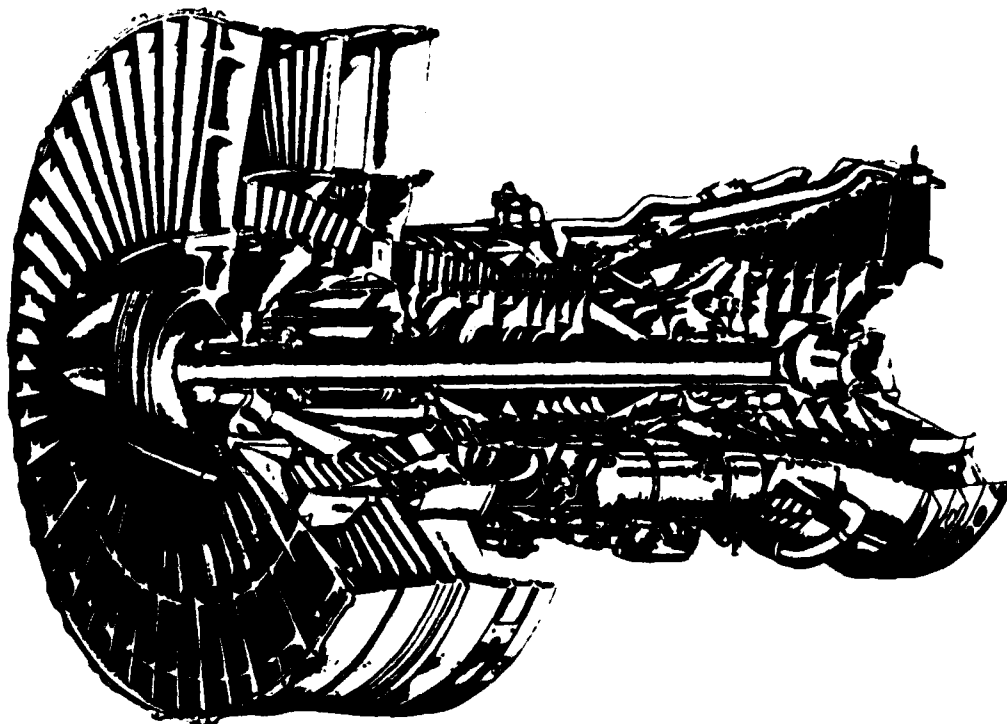


JT9D-7Q TURBOFAN ENGINE

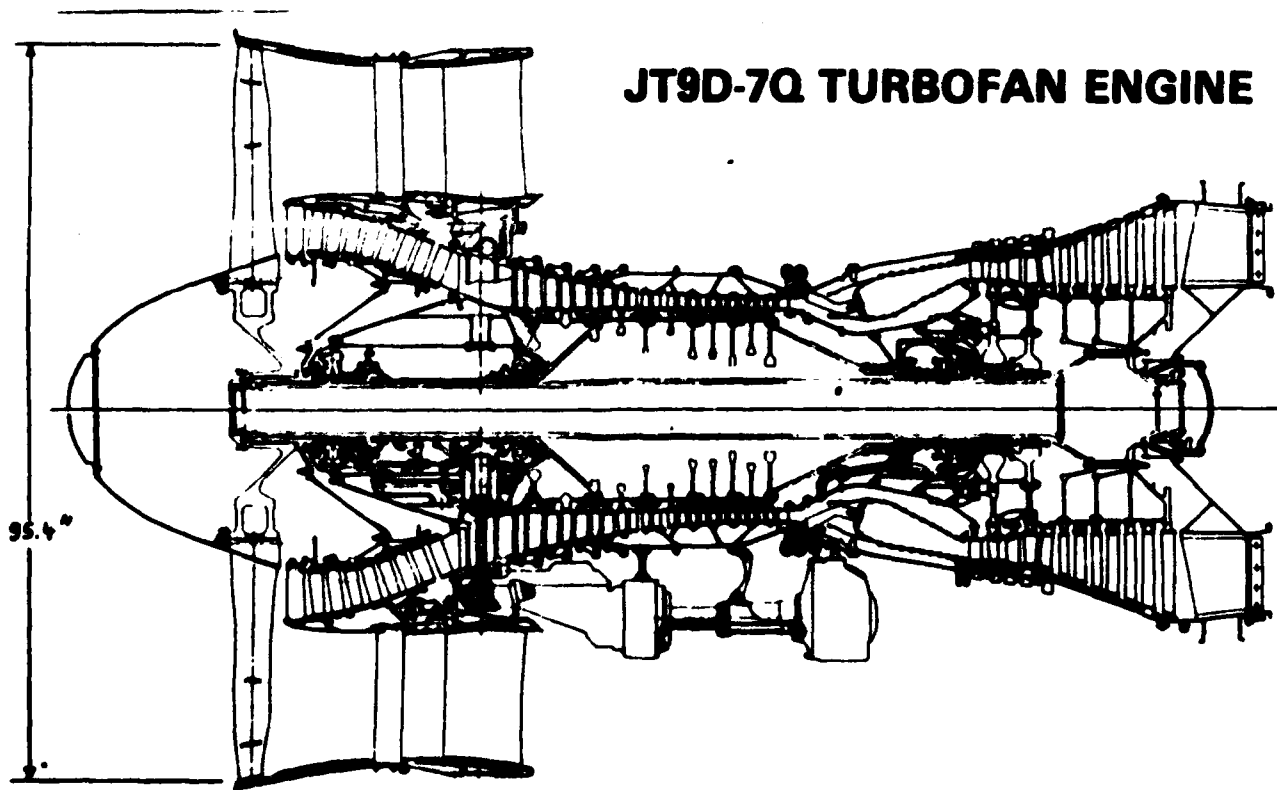




JT9D-7Q TURBOFAN

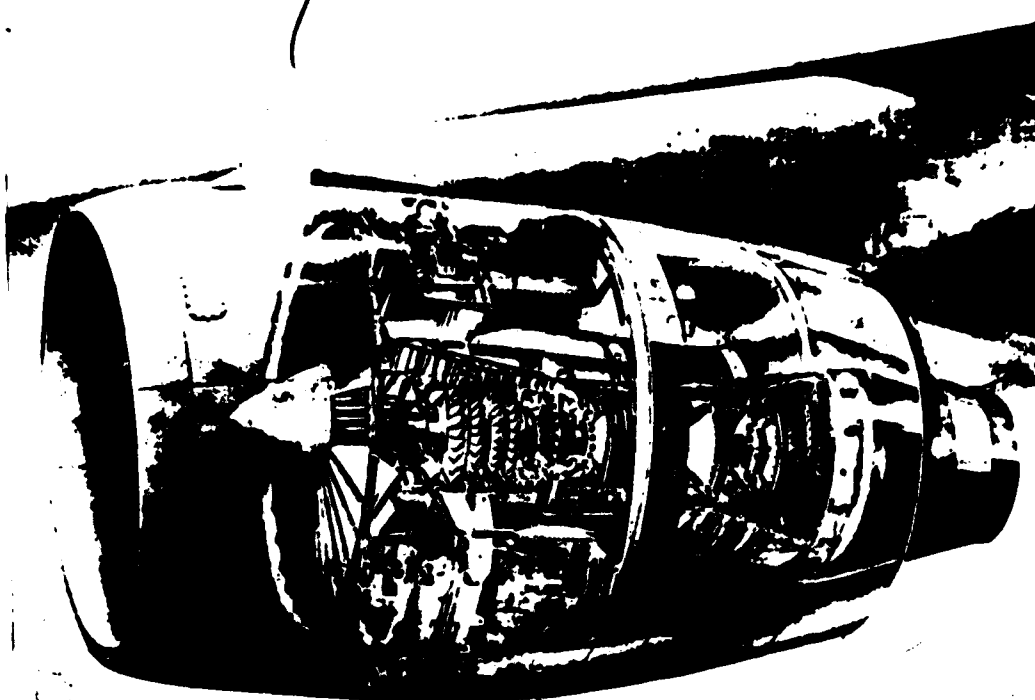


JT9D-7Q TURBOFAN ENGINE

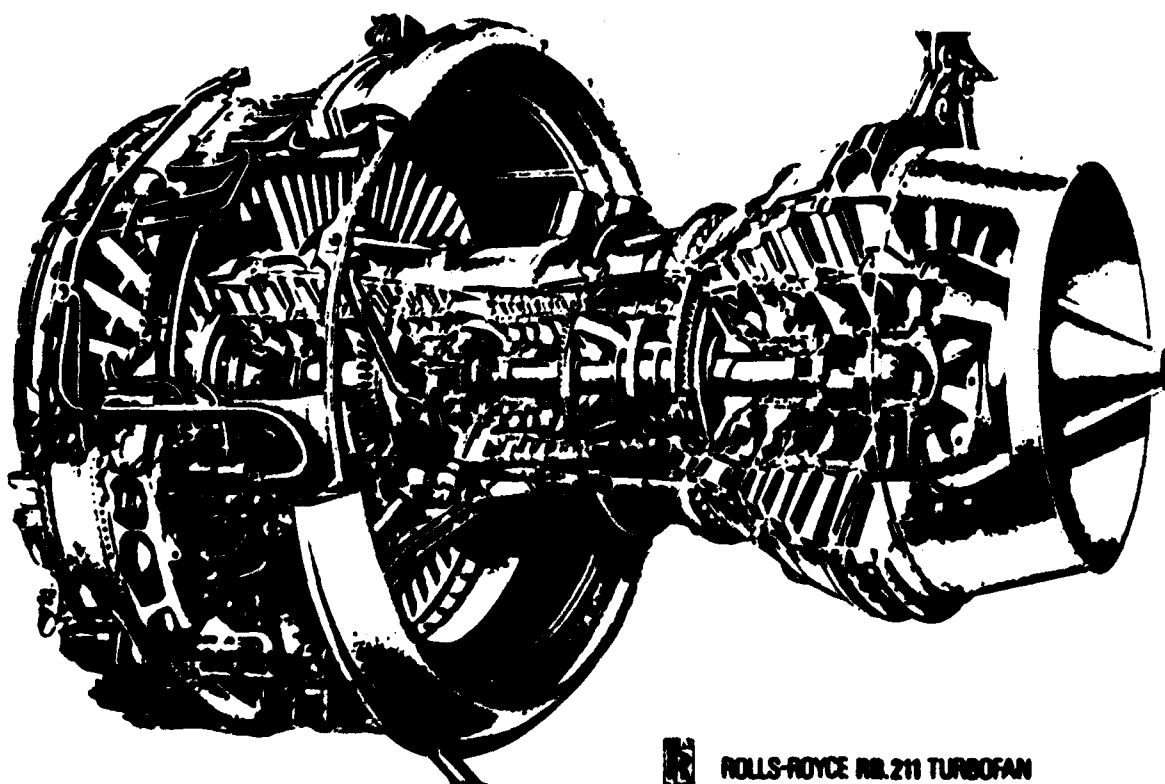


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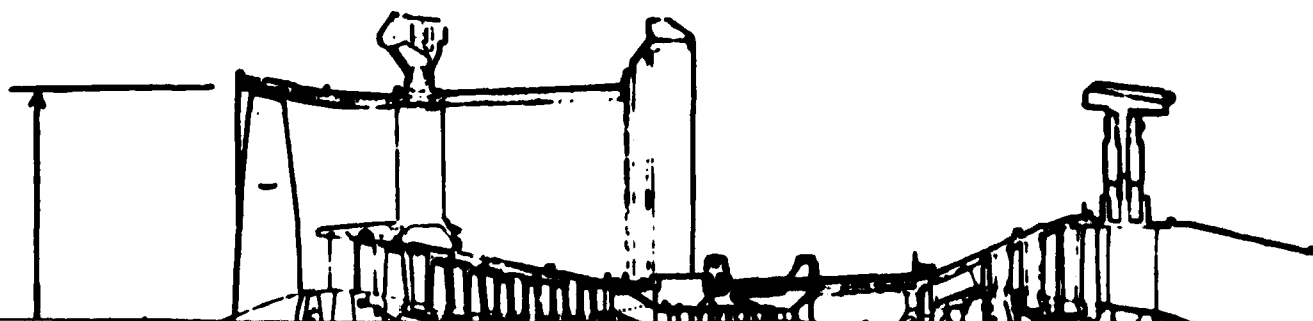
FIGURE B-3. PMA JT9D-7Q ENGINE



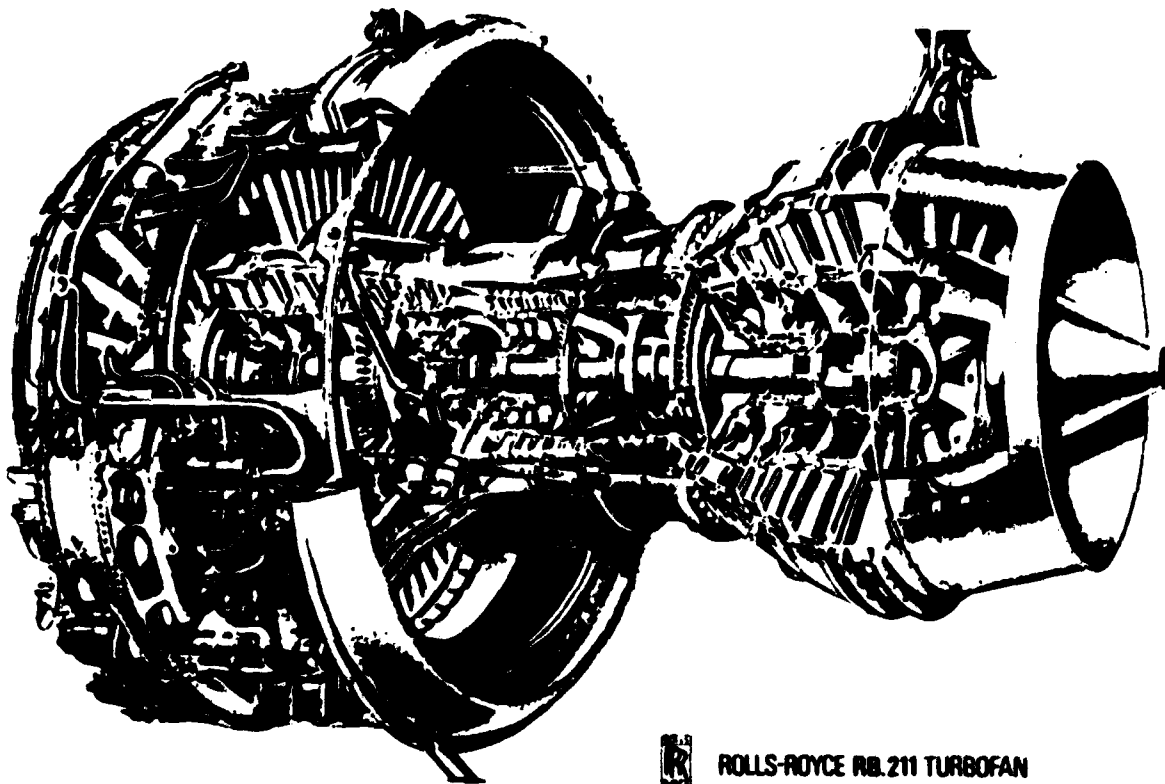
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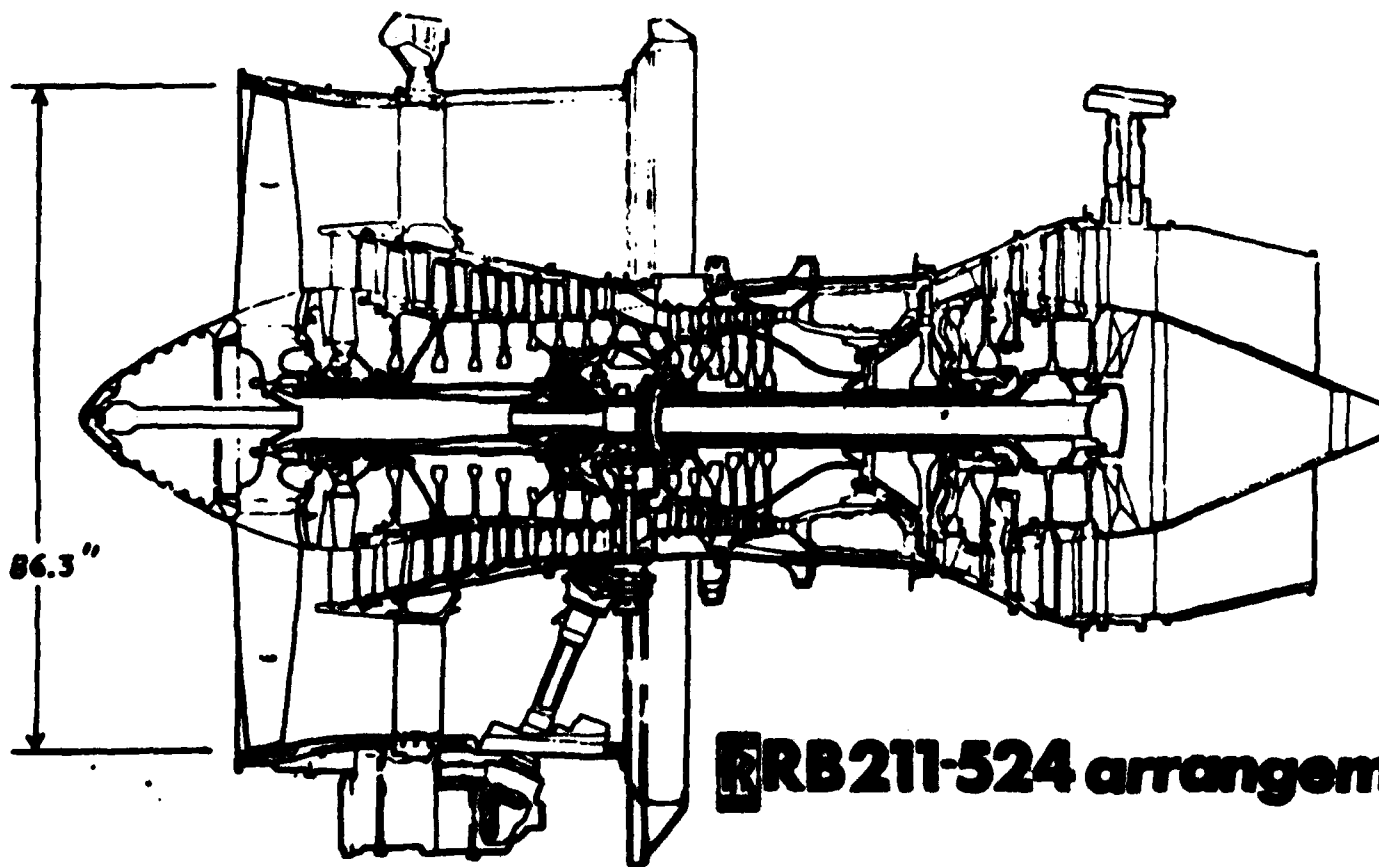
 ROLLS-ROYCE RB.211 TURBOFAN



 ROLLS-ROYCE RB211-524



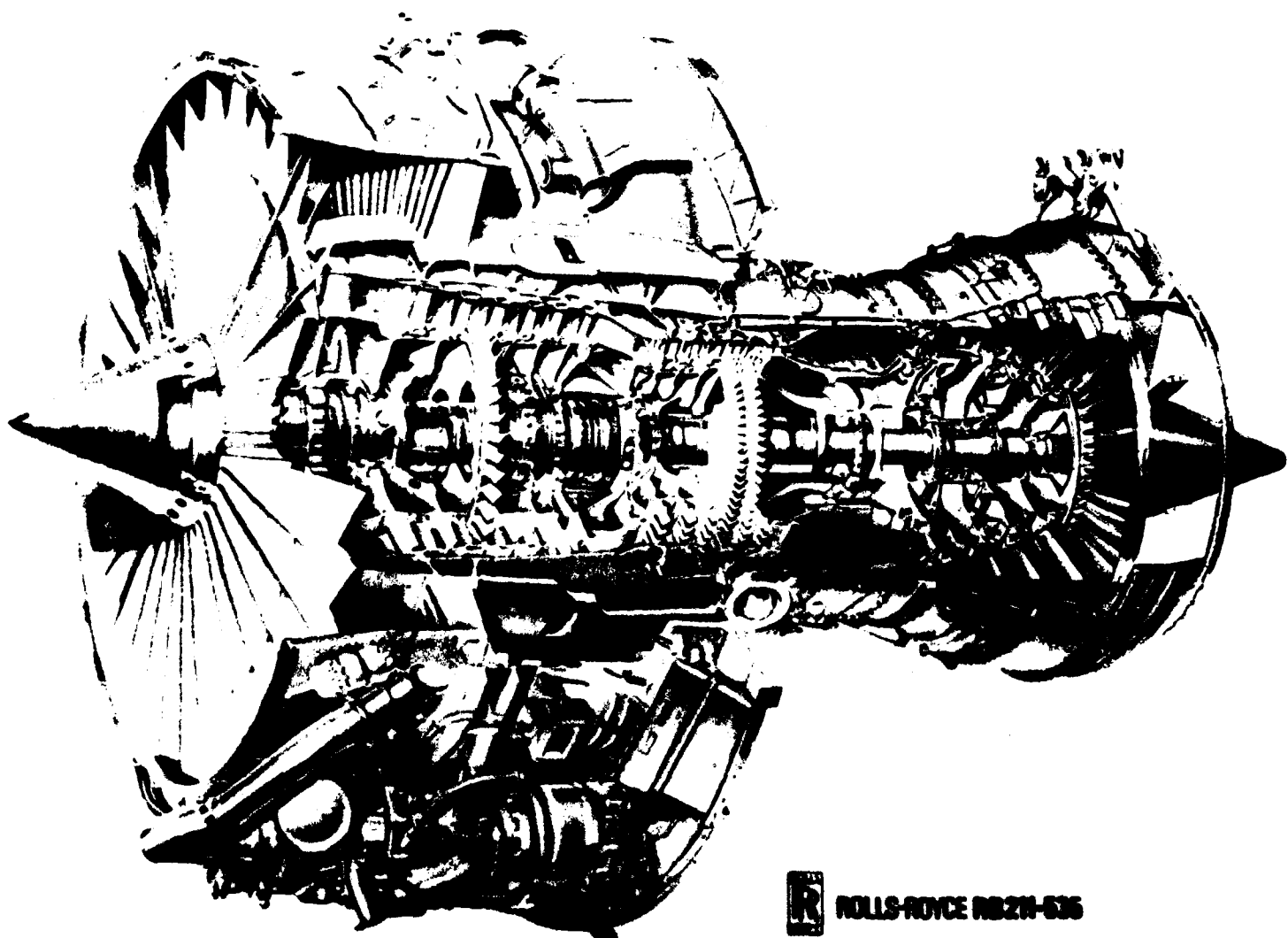
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 **RB211-524 arrangement**

84-13-5

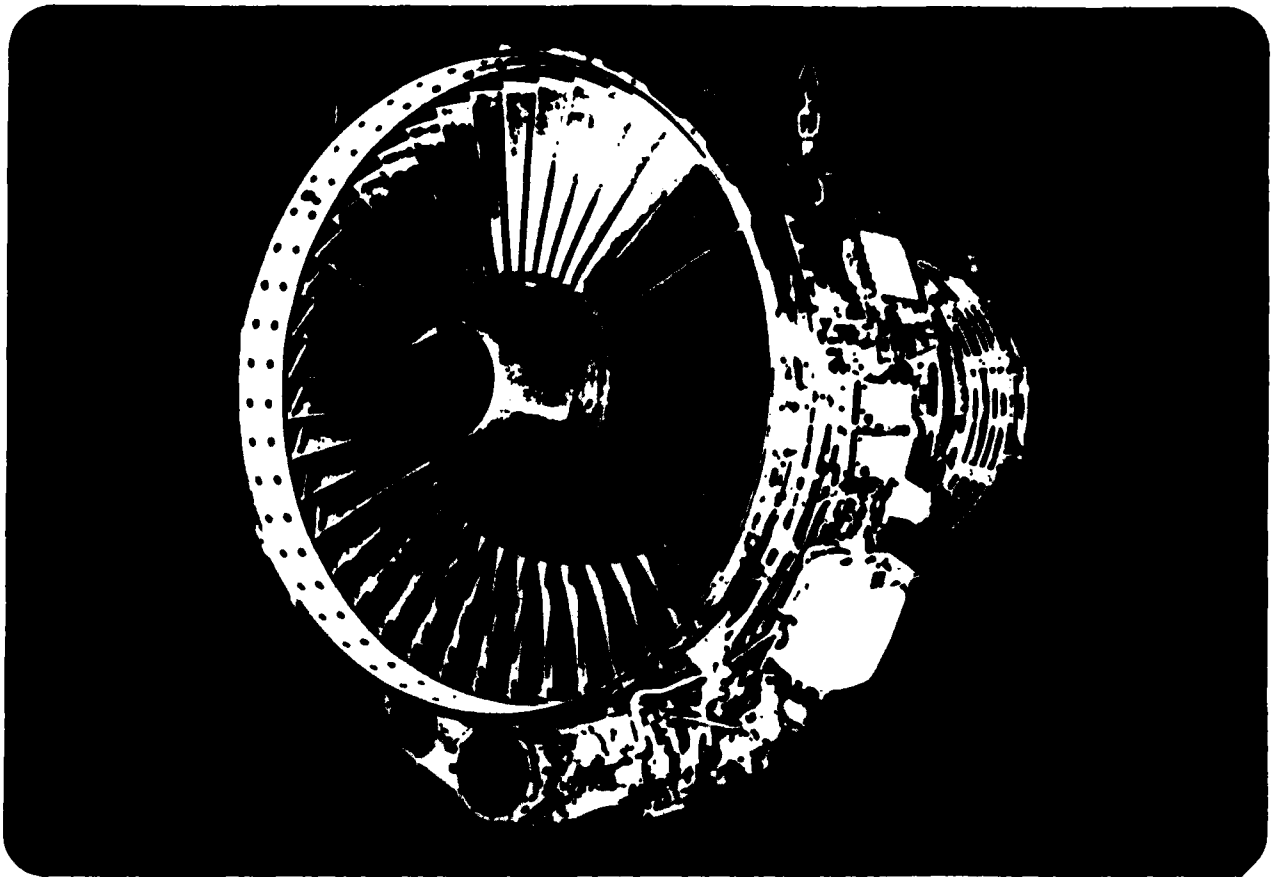
FIGURE B-5. RR RB211-524 ENGINE



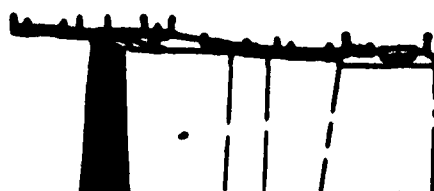
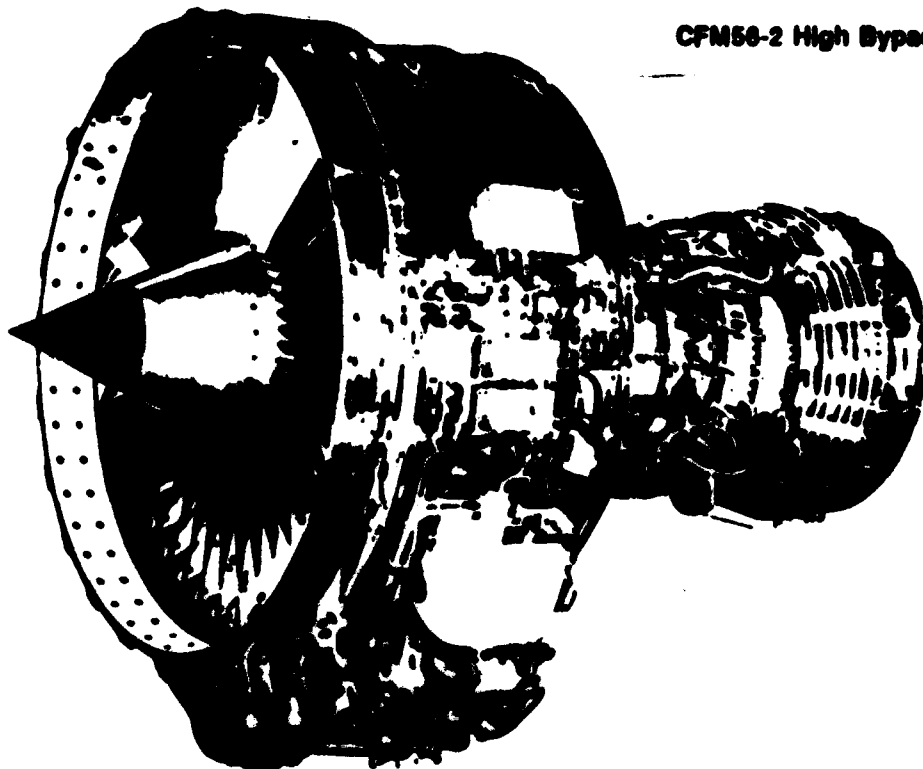
 ROLLS-ROYCE RB211-535

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FIGURE B-6. RR RB211-535 ENGINE

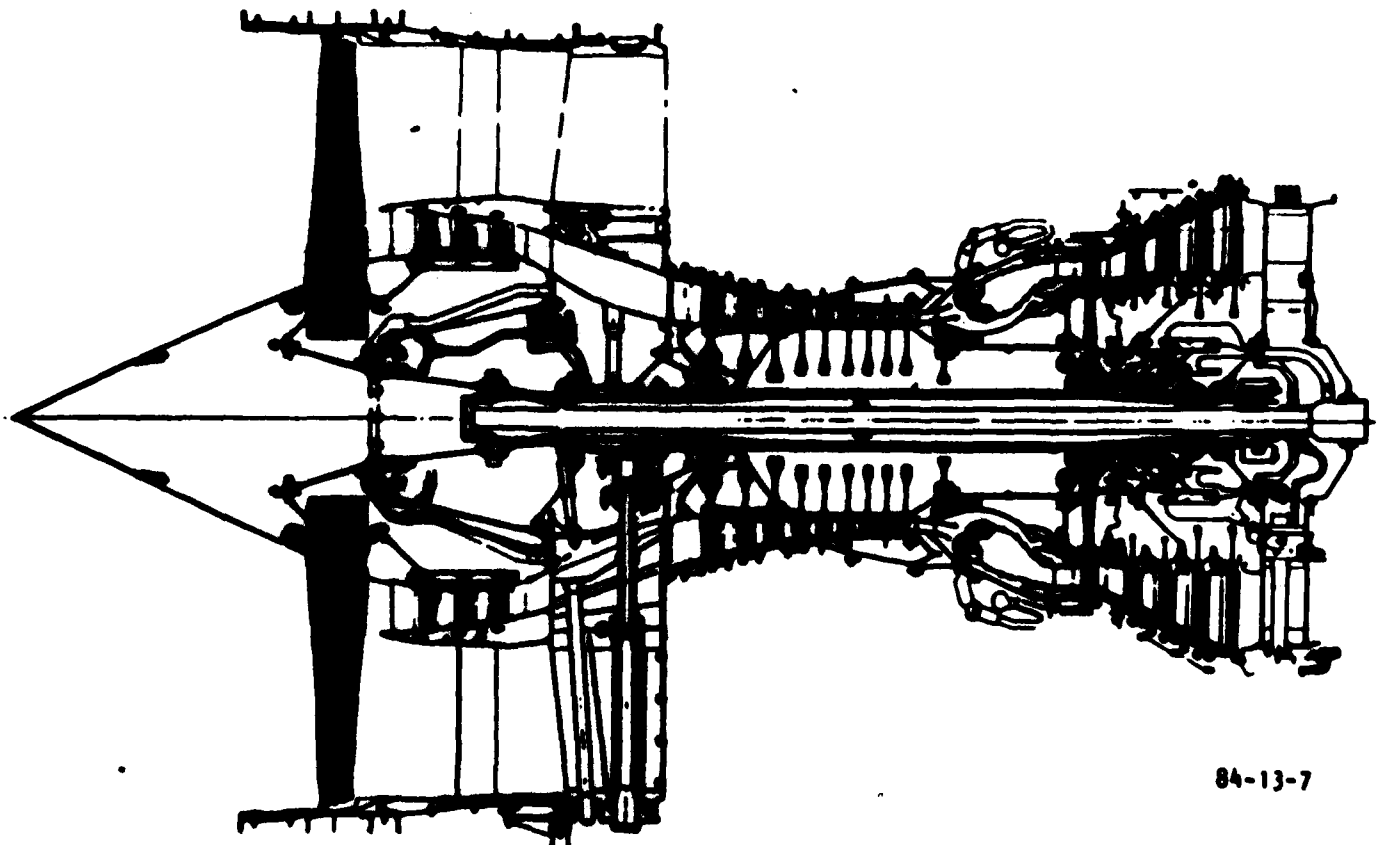
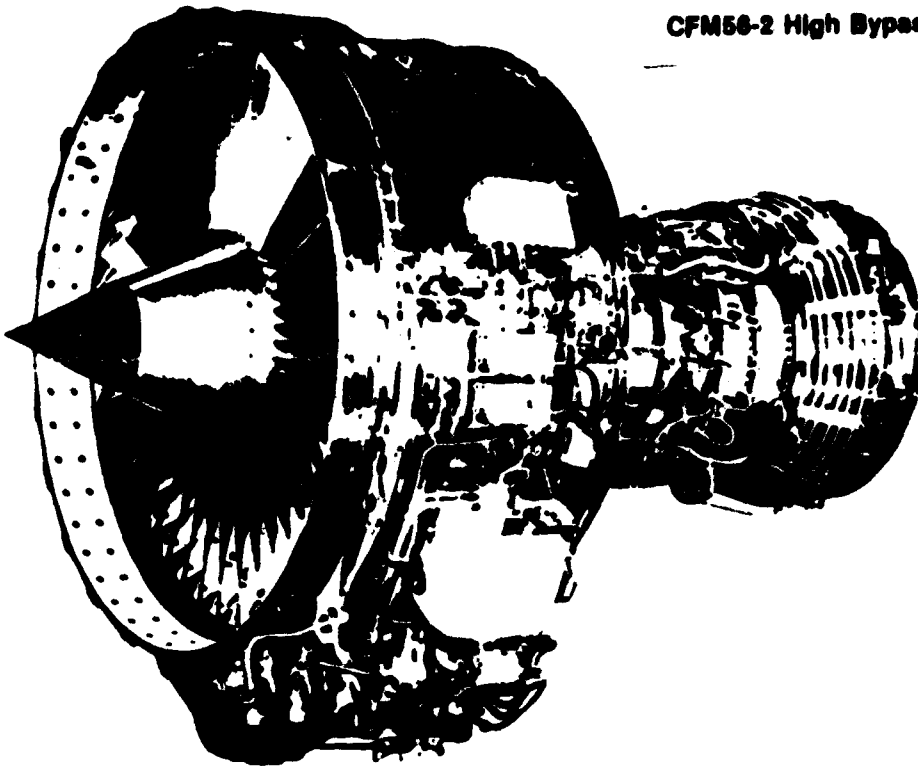


CFM56-2 High Bypass Turbofan Engine





CFM56-2 High Bypass Turbofan Engine



B-5

84-13-7

FIGURE B-7. CFM1 CFM56-2 ENGINE

2

APPENDIX C
STATISTICAL PROCEDURES

APPENDIX C

STATISTICAL PROCEDURES

C-1 KOLOMOGOROV-SMIRNOV TWO-SAMPLE TEST

The Kolomogorov-Smirnov (KS) two-sample test is a test of whether two independent samples have been drawn from the same population (or from populations with the same distribution). The two-tailed test is sensitive to any kind of differences in the distributions from which the two samples were drawn - differences in location, in dispersion, in skewness, etc.

The maximum difference (D) between the two cumulative distributions of the two samples is called KS statistics. For a large number of observations (greater than 40), the critical value of the KS distribution of difference D can be obtained from the following table for a selected significance level. If the observed difference D is greater than the critical value D, then we reject the null hypothesis. That is, the two distributions are the same.

CRITICAL VALUES OF D IN THE KOLOMOGOROV-SMIRNOV TWO-SAMPLE TEST (Large Samples Two-tailed Test)

Level of Significance	Value of D so large to call for Rejection of H_0 at the indicated level of significance.
0.10	$1.224 \sqrt{\frac{n_1 + n_2}{n_1 n_2}}$
0.05	$1.358 \sqrt{\frac{n_1 + n_2}{n_1 n_2}}$
0.025	$1.480 \sqrt{\frac{n_1 + n_2}{n_1 n_2}}$
0.01	$1.628 \sqrt{\frac{n_1 + n_2}{n_1 n_2}}$

$$\text{Where; } D = \max |S_{n_1}(x) - S_{n_2}(x)|$$

(D = max difference between two cumulative distributions.)

C-2 BIRD WEIGHT CLASS INTERVAL SELECTION METHOD

There is no exact method available in determining the class intervals. Selection of class interval is often based on judgmental factors, however, the following formula helps to determine the class interval when the judgmental factors are not available.

$$\text{Class Interval} = \frac{\text{Range}}{1 + 3.322 \times \log(n)}$$

where:

Range = largest observed value minus smallest observed value.

n = number of observations.

Log = log base 10.

The bird weight class interval of 8 oz., or its multiple, used in this study is based on the formula given above.

C-3 COMPARISON OF INGESTION RATES

In comparing the ingestion rates, we assumed that estimated rates in fact are the maximum likelihood estimates of the parameters of the Poisson distribution. For example, comparing the U.S. ingestion rate against the Foreign ingestion we assumed that rates are the estimate of the Poisson distribution parameter (λ) which is the same for both U.S. and Foreign. The number of observations being large, we invoked the asymptotic property of Poisson and used the asymptotic test rather than the exact test. Some of the asymptotic tests used are the chi-square, the normal test, and in some cases, the binomial test.

C-4 TEST OF ASSOCIATION AND HOMOGENIETY OF CONTINGENCY TABLES

To test the association between the rows and columns of the contingency tables, we employed the chi-square test of independence, as well as the chi-square test to ascertain the homogeneity of the two population observations which are drawn independently.

To measure the extent of association between the row and column factors of the contingency table, Pearson's coefficient (C) and Cramer Statistics (V) were computed as follows:

$$C = \sqrt{X^2 / (X^2 + N)}$$

$$V = \sqrt{X^2 / (N \times \min [(I-1), (J-1)])}$$

where:

X^2 , N are the Chi-square and number of observations.

I, J are the number of rows and columns respectively.

Values of C and V close to zero indicate lack of association between the row and column factors of the contingency table, whereas values closer to 1.0 indicate strong association.

APPENDIX D

BIRD TYPES, WEIGHTS, INGESTION LOCATION, AND CODES

The ingested bird species code (reference 2) as shown in this appendix is helpful for computer applications. Each order of birds was assigned a code letter according to its position in the taxonomic sequence. Each family of birds was assigned a code number according to its position within the order. Each species of bird was assigned a code number according to its position within the family. To avoid confusing numbers, the code designation was assembled by putting the family number first, the order letter second, and the species number last (for example: 3K28 not K328; also, this is the black kite (common name) which belongs to the order Falconiformes, family Accipitridae, and species *Milvus migrans*).

BIRD TYPES, WEIGHTS, INGESTION LOCATION, AND CODES

BIRD TYPE	AVERAGE WEIGHT	INGESTIONS, LOCATION			CODE
	OZS. (+RANGE)	U.S.	FOREIGN	UNKNOWN	
<u>PROCELLARIIFORMES - ALBATROSSES, PETRELS, ETC.</u>					
PROCELLARIIDAE - PETRELS, SHEARWATERS					
Pterodroma mollis - Soft-plumaged Petrel	10 (7-13)		1		2G26
<u>CICONIIFORMES - HERONS, STORKS, IBISES, FLAMINGOS</u>					
ARDEIDAE - HERONS AND BITTERNS					
Hydranassa caerulea - Little Blue Heron	12 ---		1		1142
Egretta garzetta - Little Egret	16 (10-22)		2		1150
Ardea herodias - Great Blue Heron	95 (52-208)		2		1157
CICONIIDAE - STORKS					
Anastomus lamelligerus - African Open-billed Stork	40 (22-49)		2		516
Leptoptilos crumeniferus - Marabou Stork	208 (141-314)		1		5117
THRESKIORNITHIDAE - IBISES AND SPOONBILLS					
Plegadis falcinellus - Glossy Ibis	22 (13-30)	1	1		6121
<u>ANSERIFORMES - SCREAMERS, DUCKS, GEESE, SWANS</u>					
ANATIDAE - DUCKS, GEESE, SWANS					
Dendrocygna bicolor - Fulvous Tree Duck	25 (19-32)		1		2J4
Chen caerulescens - Snow Goose	86 (43-154)		1		2J26
Branta canadensis - Canada Goose	127 (39-267)	3			2J30
Amazonetta brasiliensis - Brazilian Teal or Duck	21 (20-21)	1			2J65
Anas gibberifrons - Gray Teal	17 (12-25)		1		2J80
Anas platyrhynchos - Mallard Duck	38 (18-63)	4	5		2J84
Anas rubripes - American Black Duck	40 (25-63)	1			2J88
Anas poecilorhyncha - Spot-billed Duck	35 ---		1		2J91
Ana acuta - Common Pintail Duck	30 (14-51)		2		2J95
Anas clypeata - Northern Shoveler	21 (11-39)		1		2J108
Aythya ferina - Common Pochard	30 ---		1		2J115
Aythya affinis - Lesser Scaup	28 (19-40)		1		2J125
Lophodytes cucullatus - Hooded Merganser	22 (16-32)		1		2J138

BIRD TYPE	AVERAGE WEIGHT OZ. (+ RANGE)	INGESTIONS, LOCATION			CODE
		U.S.	FOREIGN	UNKNOWN	
<u>FALCONIFORMES - HAWKS, EAGLES, VULTURES, KITES</u>					
CATHARTIDAE - VULTURES					
Cathartes aura - Turkey Vulture	50 (31-85)	2			1K1
PANDIONIDAE - OSPREY					
Pandion haliaetus - Osprey	54 (40-72)		1	1	2K1
ACCIPITRIDAE - HAWKS, EAGLES, KITES, VULTURES					
Milvus migrans - Black Kite	28 (20-42)		46		3K28
Milvus milvus - Red Kite	36 (28-56)		2		3K29
Haliaeetus leucocephalus - Bald Eagle	181 (136-232)		1		3K37
Gyps bengalensis - Indian White-backed Vulture	187 (194-200)		3		3K46
Gyps fulvus - Griffon Vulture	282 (150-529)		2		3K51
Sarcogyps calvus - Indian Black Vulture	158 (131-190)		1		3K54
Buteo nitidus - Gray Hawk or Mexican Goshawk	17 (11-23)		1		3K163
Buteo platypterus - Broad-winged Hawk	14 ---	1	2		3K168
Buteo jamaicensis - Red-tailed Hawk	39 ---	1			3K179
Buteo buteo - Common Buzzard	28 (17-48)		3		3K180
Buteo lagopus - Rough-legged Hawk	35 (21-59)	1			3K183
FALCONIDAE - FALCONS					
Falco sparverius - American Sparrowhawk (Kestrel)	4 ---		2		5K26
Falco cherrug - Saker Falcon	36 (26-46)		1		5K54
<u>GALLIFORMES - CHICKEN-LIKE BIRDS</u>					
PHASIANIDAE - QUAILS, PHEASANTS, PEAFOWLS					
Francolinus francolinus - Black Partridge (Francolin)	16 (8-20)		5		4L44
Phasianus colchicus - Common or Ring-necked Pheasant	39 (18-71)		2	1	4L161
<u>GRUIFORMES - BUTTONQUAILS, CRANES, RAILS</u>					
RALLIDAE - RAILS, CRAKES, COOTS, GALLINULES					
Crex crex - Corncrake	5 (3-7)		1		7M49

BIRD TYPE	AVERAGE WEIGHT OZ. (+ RANGE)	INGESTIONS, LOCATION			CODE
		U.S.	FOREIGN	UNKNOWN	
<u>CHARADRIIFORMES - SHOREBIRDS</u>					
HAEMATOPODIDAE - OYSTERCATCHERS					
Haematopus ostralegus - Common Oystercatcher	18 (12-28)		2		4N1
CHARADRIIDAE - FLOWERS, LAPWINGS					
Vanellus vanellus - Common Lapwing	8 (4-11)		10		5N1
Pluvialis apricaria - Eurasian Golden Plover	7 (3-8)		3		5N25
Pluvialis squatarola - Black-bellied Plover	7 (4-11)	1	2	1	5N27
SCOLOPACIDAE - SANDPIPERS, SNIPES					
Limosa limosa - Black Tailed Godwit	10 (7-13)		2		6N1
Gallinago undulata - Giant Snipe	-----		1		6N50
BURHINIDAE - STONE CURLEWS (THICK-KNEES)					
Burhinus capensis - Spotted Thick-knee or Cape Dikkop	15 (14-16)		1		9N4
LARIDAE - GULLS, TERNS					
Larus crassirostris - Black-tailed Gull	20 (15-23)		14		14N10
Larus delawarensis - Ring-billed Gull	17 ---	8	1	2	14N12
Larus argentatus - Herring Gull	36 (21-64)	20	4	3	14N14
Larus fuscus - Lesser Black-backed Gull	29 (19-42)	1	3		14N17
Larus californicus - California Gull	24 (17-29)	1			14N18
Larus marinus - Great Black-backed Gull	60 (40-80)	2			14N21
Larus glaucescens - Glaucous-winged Gull	38 ---	2	2		14N22
Larus atricilla - Laughing Gull	10 ---	1	4		14N26
Larus cirrocephalus - Gray-headed Gull	10 (6-14)		2		14N29
Larus pipixcan - Franklin's Gull	9 ---		1		14N31
Larus novaehollandiae - Silver Gull	12 ---		5		14N32
Larus maculipennis - Brown-hooded Gull	-----		3		14N35
Larus ridibundus - Common Black-headed Gull	10 (4-14)		30	4	14N36
<u>COLUMBIFORMES - PIGEONS, DOVES, SANDGROUSES</u>					
COLUMBIDAE - PIGEONS, DOVES					
Columba livia - Common Rock Dove	14 (7-20)	2	5	1	2P1
Columba palumbus - Wood Pigeon	16 (9-26)	2	21		2P9
Streptopelia turtur - Common Turtle Dove	5 (3-6)		1	1	2P50
Zenaida macroura - Mourning Dove	4 (3-6)	2		1	2P105

BIRD TYPE	AVERAGE WEIGHT OZ. (+ RANGE)	INGESTIONS, LOCATION			CODE
		U.S.	FOREIGN	UNKNOWN	
<i>Zenaidura macroura</i> - Eared Dove	-----		1		2P106
<u>STRIGIFORMES - BARN OWLS AND TYPICAL OWLS</u>					
TYTONIDAE - BARN OWLS					
<i>Tyto alba</i> - Common Barn Owl	11 (7-23)	2	2	2	1S2
STRIGIDAE - OWLS					
<i>Asio flammeus</i> - Short-eared Owl	13 (9-18)		3		2S124
<u>CAPRIMULGIFORMES - NIGHTJARS, FROGMOUTHS</u>					
CAPRIMULGIDAE - NIGHTJARS					
<i>Caprimulgus salvini</i> - Chipwillow	2 ---		1		5T26
<u>APODIFORMES - SWIFTS, HUMMINGBIRDS</u>					
APODIDAE - SWIFTS					
<i>Cypseloides niger</i> - Black Swift	2 ---			1	1U31
<u>CORACIIFORMES - KINGFISHERS, MOTMOTS, HORN BILLS</u>					
CORACIIDAE - ROLLERS					
<i>Coracias garrulus</i> - European Roller	5 (4-6)		1		5X1
<u>PASSERIFORMES - PERCHING BIRDS</u>					
ALAUDIDAE - LARKS					
<i>Melanocorypha yeltoniensis</i> - Black Lark	2 (1-2)		1		17250
<i>Calandrella raytal</i> - Indian Sand-Lark	-----		1		17254
<i>Alauda gulula</i> - Lesser Skylark	-----		1		17273
<i>Eremophila alpestris</i> - Horned Lark	1 (1-2)	1			17274
CORVIDAE - CROWS, JAYS					
<i>Corvus splendens</i> - House Crow	11 (9-13)		1		22273
<i>Corvus frugilegus</i> - Rook	15 (10-21)		1		22284
<i>Corvus corone</i> - Carrion Crow	19 (11-24)		6		22294

BIRD TYPE	AVERAGE WEIGHT OZ. (+ RANGE)	INGESTIONS, LOCATION			CODE
		U.S.	FOREIGN	UNKNOWN	
TURDIDAE - THRUSHES					
Catharus ustulatus - Swainson's Thrush	1 —	1			412246
Turdus naumanni - Dusky Thrush	3 (3-4)		2		412279
Turdus migratorius - American Robin	3 —	1			412314
MOTACILLIDAE - WAGTAILS, PIPITS					
Anthus novaeseelandiae - Richard's Pipit	1 —		1		47221
ICTERIDAE - BLACKBIRDS & AMERICAN ORIOLES					
Sturnella neglecta - Western Meadowlark	4 (3-4)		1		64268
Molothrus ater - Brown-headed Cowbird	2 (1-2)	1			64294
FRINGILLIDAE - FINCHES, GROSBEAKS, SPARROWS					
Pringilla coelebs - Common Chaffinch	1 —		1		68241
ESTRILDIDAE - WAXBILLS					
Lonchura malacca - Chestnut Munia	1 —		1		692104
Amadina erythrocephala - Red-headed Finch	1 —		1		692124
<u>OTHER CATEGORIES</u>					
Bats (included due to flight behavior)	1 —		2		992999

APPENDIX E

DATA BASE

APPENDIX E

DATA BASE

Legend

1. FAA Bird Ingestion event number (EVT #)
2. Data (month, day, year) (DATE)
3. Local time (TIME)
4. Aircraft type (AC)
5. Engine Position (ENG POS)
6. Airport (ARPT)
7. Phase of Flight (FLIGHT PHASE)
8. Weather (WX)
9. Engine Damage Codes (DAMAGE)
10. Power Loss or Power Reduction (POWER LOSS/RED)
11. Was the damage contained within the nacelle? (CONT DAMG)
12. Reason for in-flight shutdown of engine (IFSD REASON)
13. Was the bird seen prior to the ingestion? (BIRD SEEN)
14. Species of bird ingested (BIRD SPECIES) (Referenced in Appendix D)
15. Number of birds ingested (# BD). An entry of "9" in this column indicates a flock, not nine birds. The bird number is unknown but is assumed to be greater than six birds.
16. Average weight of the bird in ounces (AV WT OZ)
17. Pilot reaction to bird ingestion (PILOT ACT)
18. Important/unusual circumstances regarding this bird ingestion event (SIGNIFICANT REASON)

The legend lists the information contained in this Appendix. It was not possible in all cases to obtain all the information desired. For example, when the local time of the ingestion is unknown, the column entry is listed as "0000". Likewise, when the number of birds or bird weight are unknown, the column entry is "0". In all other cases an unknown quantity is listed as "UNK". In those cases where a particular column entry does not apply, the term "N/A" is entered. An example of this might be a case wherein a bird ingestion has occurred but no damage resulted, therefore, the "IFSD REASON", "PILOT ACT", and "SIGNIFICANT REASON" columns may all have an "N/A" entry. The "EVT #" is computer generated and sequential by date of bird ingestion occurrence. The term "EVENT", as used in this report, refers to an aircraft bird ingestion occurrence. More than a single computer line entry in Appendix E, having the same number, indicates multiple engine involvement. The only exceptions to this are events #3 and #220, which are not multiple engine events, however, two different bird species were ingested into the engine at the same time.

The following codes refer to entries in Appendix E.

AIRCRAFT (AC)

- 1 - DC8
- 2 - DC10
- 3 - A300
- 4 - B747
- 5 - B757
- 6 - B767
- 7 - L1011
- 8 - A310

WEATHER (WX)

- IFR - Instrument Flight Rules
- VFR - Visual Flight Rules
- UNK - Unknown

(DAMAGE)

(See Text)

(Bird Species)

(See Appendix D)

INFLIGHT ENGINE SHUTDOWN (IFSD REASON)

N/A - Not applicable

Vibes - Engine vibrations

Stal/Srg - Compressor Stall/Surge

Hi Egt - High Exhaust Gas Temperature

Epr - Incorrect Engine Pressure Ratio

Involtry - Involuntary engine shutdown

Paramtrs - Incorrect engine parameters

Other - Other reasons not listed

UNK - Unknown reason

PILOT ACTION (PILOT ACT)

N/A - Not applicable

ATO - Aborted Takeoff

ATB - Air turnback

UNK - Unknown

(SIGNIFICANT REASON)

N/A - Not applicable

Eng Mult - Multiple Engine ingestion

Bds Mult - Multiple Bird ingestion

IPWRLOSS - Involuntary power loss

TRVSFRAC - Transverse fan blade fracture

AIRWRTHY - Engine related airworthiness effects

OTHER - Other significant reasons

DATA RECORDED & PROCESSED AT FAA TECHNICAL CENTER, ATLANTIC CITY AIRPORT, N.J. ORLOS ON 07/14/84 G FRINGS ACT-120 UNIT 6 PAGE 2

ENG POS A ENG POS
 TIME C
 DATE
 LOSS CONT IFSD BIRD BIRD U M LOT SIGNI-
 DAMAGE /DED DANG REASON SEEN SPECIES 6 32 ACT REASON

1	050381	0000	2	1	ADJ	CLIMB	UNK	2	YES	YES	VIBES	UNK	0X	0	3	3	ATO	N/A
2	050481	0814	3	2	GRV	TO	VFR	2	YES	YES	N/A	YES	2P	0	2	110	ATO	ENG MULT
2	050481	0814	3	1	GRV	TO	VFR	2	YES	YES	N/A	YES	2P	0	2	110	ATO	ENG MULT
1	050481	1230	7	3	VFR	TO	VFR	29	YES	YES	VIBES	YES	2J	84	1	49	ATO	005 MULT
3	050481	1230	7	3	VFR	TO	VFR	29	YES	YES	VIBES	YES	222	94	1	24	ATO	005 MULT
4	051081	0000	3	2	0000	TO	UNK	45789	YES	NO	N/A	UNK	3K	24	1	28	ATO	TRUSFRAC
5	051981	0000	4	3	RRR	UNK	UNK	2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A
6	051981	0000	2	1	RRR	UNK	UNK	2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A
7	052281	0000	4	4	XFO	UNK	UNK	1	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A
8	052381	1430	4	3	XFO	UNK	VFR	48	NO	YES	N/A	NO	4L	44	1	17	N/A	N/A
9	052781	0000	3	1	FCO	LANDING	UNK	1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A
10	052881	1422	7	2	ARR	TO	UNK	1	YES	N/A	VIBES	YES	0X	0	0	0	N/A	N/A
11	053081	1730	4	2	JFK	CLIMB	UNK	4	NO	YES	N/A	NO	0X	0	1	14	N/A	N/A
***** SAMPLE SIZE FOR MAY 81 = 11 8 STRIKES WITH DAMAGE = 8 3 = 72.727																		
12	060281	0432	5	2	LVS	TO	VFR	1	NO	YES	N/A	YES	3K	29	1	36	N/A	N/A
13	060381	0000	4	3	MUM	TO	UNK	7	NO	YES	N/A	UNK	14W	22	1	40	N/A	N/A
14	060381	0000	3	2	BUR	TO	UNK	2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A

DATE	TIME	A	ENG	POS	FLIGHT	ARPT	PHASE	WZ	DAMAGE	LOSS	COMT	IFSD	BIRD	SEEN	SPECIES	D	OZ	ACT	REASON	AV	PI-	SIGNI-
15	060551	0127	4	6	TLV	TO	VFR	2	NO	YES	N/A	NO	15	2	1	16	N/A	N/A				
16	060851	0000	2	3	VCP	TO	UNK	2	YES	YES	N/A	UNK	0X	0	0	0	ATB	N/A				
17	061051	0000	3	1	XFO	UNK	UNK	7	NO	YES	N/A	UNK	3K	29	1	32	N/A	N/A				
18	061051	1229	4	4	LHR	TO	UNK	4569	YES	YES	MI	EGT	UNK	2P	1	2	11	ATB	TRVSTRAC			
19	061251	0000	3	2	KHI	TO	VFR	2	YES	YES	N/A	UNK	3K	24	1	24	N/A	N/A				
20	061351	0000	4	6	LVS	LANDNG	VFR	1	N/A	N/A	N/A	UNK	3K189	0	28	0	N/A	N/A				
21	061351	0000	4	4	RER	UNK	UNK	2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A				
22	061351	0000	4	4	CHI	LANDNG	UNK	4	UNK	UNK	N/A	UNK	0X	0	2	0	UNK	N/A				
23	061451	0000	4	6	XFO	UNK	UNK	1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A				
24	061551	0700	7	3	PHL	LANDNG	VFR	489	NO	YES	N/A	NO	14N	14	1	48	N/A	N/A				
25	061651	0000	2	1	DER	TO	VFR	2	YES	N/A	N/A	UNK	0X	0	0	0	N/A	N/A				
26	061651	0000	2	1	CDG	UNK	UNK	2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A				
27	061751	0450	3	1	LVS	TO	VFR	2	YES	YES	N/A	YES	0X	0	0	0	N/A	N/A				
28	061751	1729	3	1	ORY	TO	VFR	2	YES	YES	N/A	YES	2P	9	1	16	N/A	N/A				
29	061751	0000	3	1	XFO	UNK	UNK	1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A				
30	061851	1514	3	2	ORY	TO	VFR	1	NO	YES	N/A	YES	2P	9	2	16	N/A	N/A				

DATA RECORDED & PROCESSED AT FAA TECHNICAL CENTER, ATLANTIC CITY AIRPORT, N.J. DRACOS ON 07/16/84 G FRINGS ACT-320 UNIT 6 PAGE 2

RTA DATE TIME C A ENG POS FLIGHT PHASE WE DAMAGE LOSS COMT TISSO BIRD BIRD B AV PL- SIGNI-
WT LOT PIGANT
SEEN SPECIES D OZ ACT REASON

31	061981	0000	4	3	AMS	TO	UNK	2	YES	YES	VIRES	UNK	0x	0	0	0	ATB	N/A	
32	061981	0000	4	1	GL3	LANDING	UNK	28	NO	YES	N/A	UNK	0x	0	0	0	ATB	N/A	
33	062081	0000	2	1	KAN	TO	UNK	4	YES	YES	VIRES	UNK	3K	24	1	24	UNK	N/A	
34	062281	0000	2	3	XXX	UNK	UNK	2	NO	YES	N/A	NO	0x	0	0	0	N/A	N/A	
35	062381	0000	7	1	JFK	APPROCH	VFR	1	NO	N/A	N/A	YES	14N	14	1	36	N/A	N/A	
36	062381	0000	4	3	HND	APPROCH	IFR	1	NO	YES	N/A	YES	0x	0	0	0	N/A	BDS	
37	062581	0000	7	3	XXX	UNK	UNK	1	NO	N/A	N/A	NO	1U	31	1	2	N/A	N/A	
38	062581	0000	4	2	DER	TAXI	UNK	1	UNK	YES	N/A	NO	4L	44	1	10	N/A	N/A	
39	062681	2037	3	1	LVS	LANDING	IFR	1	NO	YES	N/A	NO	0x	0	0	0	N/A	N/A	
40	062781	0000	4	1	LIS	TO	UNK	4	NO	YES	N/A	YES	2P	1	1	10	N/A	N/A	
41	062781	0700	4	4	JNB	TO	VFR	7	YES	YES	MI	EGT	UNK	14N	29	1	16	ATO	IPURR
42	062881	0000	3	1	NPL	LANDING	VFR	1	NO	N/A	N/A	UNK	0x	0	1	35	UNK	N/A	
43	062881	0000	3	1	XXX	UNK	UNK	1	NO	N/A	N/A	NO	15	2	1	16	N/A	N/A	
44	062981	0000	4	1	NVL	TO	UNK	8	NO	N/A	N/A	UNK	0x	0	0	0	N/A	N/A	

***** SAMPLE SIZE FOR JUN 81 = 33 # STRIKES WITH DAMAGE = 21 Z = 43.636

45	070381	0000	3	1	DEL	LANDING	VFR	7	NO	YES	N/A	UNK	3K	28	1	24	N/A	N/A
46	070381	0000	4	2	RUS	UNK	UNK	2	NO	YES	N/A	NO	0x	0	1	0	N/A	N/A

ENTR	DATE	TIME	A	ENG	POS	FLIGHT	ARPT	PHASE	W	DAMAGE	LOSS	COMT	IFSD	BIRD	SEEN	SPECIES	0	02	ACT	REASON	AV	PI-	SIGNI-
47	070381	0000	4	0	XXX	UNK	UNK	1	NO	N/A	N/A	N/A	NO	OX	0	0	0	0	0	N/A	N/A		
48	070651	0435	5	2	HOB	LANDNG	VFR	2	NO	YES	N/A	N/A	YES	3K	29	1	20	N/A	N/A				
49	070651	0000	2	3	LGW	TO	UNK	4589	YES	NO	INVLTURY	UNK	2P	9	2	18	ATB	TRVSFRAC					
50	070851	0000	4	1	CDG	TO	VFR	2	YES	YES	N/A	N/A	UNK	OX	0	0	0	0	ATB	N/A			
51	071051	0000	3	2	MRS	APPRCH	UNK	1	NO	N/A	N/A	N/A	UNK	OX	0	0	0	0	N/A	N/A			
52	071051	0000	4	1	XXX	UNK	VFR	1	NO	YES	N/A	N/A	NO	OX	0	1	0	N/A	N/A				
53	071051	1930	7	1	ATL	TO	VFR	2	YES	YES	N/A	N/A	YES	2P	9	1	16	ATO	N/A				
54	071151	0000	2	3	MCO	TO	UNK	2	NO	YES	N/A	N/A	NO	SM	1	1	13	N/A	N/A				
55	071351	0000	3	1	XFO	UNK	UNK	2	NO	YES	N/A	N/A	NO	OX	0	0	0	N/A	N/A				
56	071451	0000	3	2	DBR	LANDNG	VFR	1	NO	N/A	N/A	N/A	UNK	OX	0	0	0	N/A	N/A				
57	071451	0000	3	2	MCC	TO	VFR	1	YES	N/A	N/A	N/A	YES	SK	26	0	4	ATO	N/A				
58	071651	0000	3	2	XFO	UNK	UNK	1	N/A	N/A	N/A	N/A	NO	ST	26	1	2	N/A	N/A				
59	071651	2123	4	4	JFK	TO	VFR	2	NO	YES	STAL-SRG	UNK	14N	14	2	40	ATB	N/A					
60	071751	0815	3	1	ORY	TO	VFR	2	YES	YES	N/A	N/A	YES	2P	9	1	16	ATB	N/A				
61	071951	0000	4	2	XXX	UNK	UNK	1	NO	N/A	N/A	N/A	UNK	2P	50	1	4	N/A	N/A				
62	071951	0000	2	1	XUS	UNK	UNK	2	NO	YES	N/A	N/A	NO	OX	0	0	0	N/A	N/A				

ROUTE	DATE	TIME	A	ENG	POS	FLIGHT	W	DAMAGE	LOSS	CONT	IFSD	BIRD	SP	ACT	REASON	PI	ACT	REASON
						PHASE						SPECIES						
63	072151	0000	2	1	XFO	UNK	UNK	2	NO	YES	N/A	NO	OX	0	0	0	0	N/A
64	072151	2145	4	1	LHR	TO	UNK	458	YES	NO	VIRFS	YES	14N	16	3	10	ATB	TRVSRAC
65	072251	0000	2	3	XUS	UNK	UNK	2	NO	YES	N/A	NO	OX	0	1	0	N/A	N/A
66	072551	0000	4	2	XUS	UNK	UNK	1	NO	YES	N/A	NO	14N	14	1	16	N/A	N/A
67	072651	1200	7	3	BOM	LANDING	IFR	?	NO	YES	N/A	NO	222	73	1	11	N/A	N/A
68	073151	0000	7	2	LHR	TO	UNK	R	NO	YES	N/A	YES	14N	36	1	10	N/A	ENG MULT
68	073151	0000	7	3	LHR	TO	UNK	2	NO	YES	N/A	YES	14N	36	1	10	N/A	ENG MULT
***** SAMPLE SIZE FOR JUL 81 = 24 # STRIKES WITH DAMAGE = 16 Z = 1.66,667																		
69	080151	0000	3	1	TLS	TO	UNK	2	NO	YES	N/A	UNK	OX	0	0	0	0	N/A
70	080151	0000	4	4	NGS	TO	VFR	2	UNK	YES	N/A	UNK	3K	28	1	28	UNK	N/A
71	080251	0000	4	2	BOM	TO	IFR	20	NO	YES	N/A	NO	3K	28	1	40	N/A	N/A
72	080251	0000	4	1	MND	LANDING	UNK	20	NO	YES	N/A	UNK	OX	0	0	0	0	N/A
73	080251	0000	4	1	YUL	APPROCH	UNK	?	NO	YES	N/A	UNK	2J13R	1	19	N/A	N/A	
74	080451	0000	3	2	DEL	LANDING	UNK	1	NO	YES	N/A	UNK	3K	28	1	24	N/A	N/A
75	080751	0000	3	1	KHI	LANDING	UNK	1	NO	N/A	N/A	UNK	3K	28	1	24	N/A	N/A
76	080751	1200	4	2	MND	TO	UNK	1	NO	YES	HI EGT	YES	11	42	1	24	ATB	N/A
77	080751	2133	7	2	PML	DESCENT	UNK	1	NO	N/A	N/A	YES	OX	0	1	0	N/A	N/A

E-8

DATA RECORDED & PROCESSED AT FAA TECHNICAL CENTER, ATLANTIC CITY AIRPORT, N.J. ORLOGS ON 07/16/84 G FRINGS ACT-320 UNIT 6 PAGE 7

ENG POS A TIME C
 LOSS CONT IFSD BIRD B PT- SIGHT-
 /RED DAMG PRASON SEEN SPECIES D OZ ACT REASON

78	080751	2350	7	1	TUL	TAXI	VFR 1	NO	N/A	N/A	NO	OX	0	0	0	N/A	N/A
79	080851	0000	4	1	XXX	UNK	UNK 2	NO	YES	N/A	NO	OX	0	0	0	N/A	N/A
80	080851	0000	4	1	JOM	TO	UNK 499	NO	YES	N/A	UNK	3K	28	1	32	ATO	N/A
81	080851	0000	4	4	XXX	UNK	UNK 1	NO	YES	N/A	NO	2PTOS	1	4	N/A	N/A	
82	080951	0430	7	3	LCA	TO	UNK 1	YES	N/A	N/A	YES	7M	49	1	7	ATO	N/A
83	080851	0651	7	3	KMI	TO	IFR 2	NO	YES	N/A	YES	3K	28	1	24	N/A	N/A
84	080951	0000	3	1	DEL	LANDING	VFR 1	NO	N/A	N/A	UNK	5K	1	1	5	N/A	N/A
85	080951	0000	4	4	XFO	UNK	UNK 79	NO	YES	N/A	NO	OX	0	1	0	N/A	N/A
86	081251	0000	3	2	SXR	LANDING	UNK 1	NO	YES	N/A	NO	OX	0	0	0	N/A	N/A
87	081451	0000	3	1	HAW	UNK	UNK 1	NO	N/A	N/A	UNK	OX	0	0	0	N/A	N/A
88	081451	0000	7	1	XXX	UNK	VFR 2	NO	YES	N/A	NO	2P	1	1	11	N/A	N/A
89	081631	0000	7	3	XFO	UNK	VFR 1	NO	N/A	N/A	NO	3K	28	1	26	N/A	N/A
90	081751	0000	2	3	FIM	TO	UNK 2	UNK	YES	VIBES	UNK	OX	0	0	0	ATO	N/A
91	081751	0000	4	4	XXX	UNK	UNK 2	NO	YES	N/A	NO	OX	0	1	0	N/A	N/A
92	081851	0000	7	3	XFO	UNK	UNK 1	NO	N/A	N/A	NO	OX	0	0	0	N/A	N/A
93	081951	0000	3	1	DEL	LANDING	UNK 47	NO	YES	N/A	UNK	3K	28	1	28	N/A	N/A

DATA RECORDED & PROCESSED AT FAR TECHNICAL CENTER, ATLANTIC CITY AIRPORT, N.J. ORANS ON 07/16/84 G SPRINGS ACT-320 UNIT 6 PAGE 8

ENTRY	DATE	TIME	A	ENG	POS	FLIGHT	ARRPT	PHASE	WZ	DAMAGE	LOSS	CONT	IFSD	BIRD	SEEN	SPECIES	AV	PI-	SIGNI-	
94	081981	0000	3	2		WAA	TO	VFR	27	NO	YES	N/A	UNK	0X	0	0	0	0	N/A	N/A
95	082081	1643	3	2		COG	TO	VFR	2	YES	YES	N/A	YES	2P	9	1	11	ATO	N/A	
96	082081	0000	4	3		XXX	UNK	UNK	1	NO	YES	N/A	NO	0X	0	0	0	0	N/A	N/A
97	082181	0402	4	2		LHR	LANDING	VFR	1	NO	YES	N/A	YES	14N	29	2	10	N/A	N/A	
98	082381	0930	2	1		MND	APPROCH	IFR	1	NO	YES	N/A	YES	14N	10	9	20	N/A	ENG MULT	
98	082381	0930	2	3		MND	APPROCH	IFR	1	NO	YES	N/A	YES	14N	10	9	20	N/A	ENG MULT	
99	092481	0000	2	1		LIN	TO	VFR	4	YES	YES	N/A	UNK	222	94	1	17	ATO	N/A	
100	082581	0000	2	3		FCO	TO	VFR	2	YES	YES	N/A	UNK	0X	0	0	0	0	N/A	N/A
101	082581	0000	2	3		DEA	UNK	UNK	2	NO	YES	N/A	YES	5M	25	2	6	N/A	ODS MULT	
102	082581	0000	2	1		XXX	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	0	0	0	N/A	ENG MULT
102	082581	0000	2	3		XXX	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	0	0	0	N/A	ENG MULT
103	082681	0000	2	1		FUE	APPROCH	UNK	1	NO	YES	N/A	YES	2P	9	1	10	N/A	N/A	
104	082681	0000	2	3		GRD	TO	UNK	4559	YES	YES	VIRES	UNK	14N	12	4	15	ATO	TRUSFRAC	
105	082681	0000	4	2		EUS	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	1	0	N/A	N/A	
106	082681	0750	4	1		CPH	TO	UNK	1	UNK	N/A	N/A	UNK	14N	14	1	40	UNK	N/A	
107	082781	1925	4	2		MND	TO	VFR	2	NO	YES	N/A	NO	14N	10	1	20	N/A	N/A	

ENV#	DATE	TIME	C	ENG	POS	FLIGHT	ARPT	PHASE	WX	DAMAGE	LOSS	CONT	IFSD	BIRD	SEEN	SPECIES	0	02	ACT	REASON	AV	PI-	SIGNI-
											POUR												
108	082981	0000	2	1	MYV	TO	VFR	2		YES	YES	N/A	UNK	3K163	1	29	N/A	N/A					
109	082981	0000	4	2	RXX	UNK	UNK	2		NO	YES	N/A	NO	OX	0	1	0	N/A	N/A				
110	082981	0730	4	1	MLG	TO	VFR	70		YES	YES	STAL/SRG	YES	14W	17	1	32	ATD	N/A				
											MI	EGT											
111	082981	1900	2	3	OSA	LANDING	VFR	1		NO	N/A	N/A	NO	902000	9	10	N/A	N/A					
112	082981	2030	4	4	OSA	APPROCH	VFR	1		NO	N/A	N/A	NO	902000	9	10	N/A	N/A					
113	083081	0000	2	2	SNN	TO	UNK	2		YES	YES	N/A	UNK	2P	1	1	11	N/A	N/A				
114	083081	0000	2	3	BKK	LANDING	UNK	7		NO	N/A	N/A	UNK	OX	0	1	3	N/A	N/A				
115	083181	0000	2	1	LAX	TO	UNK	2		NO	YES	N/A	YES	14W	18	2	240	ATO	BDS	MULT			
***** SAMPLE SIZE FOR AUG 81 = 47 8 STRIKES WITH DAMAGE = 26 Z = 55.319																							
116	090181	0000	3	2	STR	LANDING	VFR	1		NO	N/A	N/A	UNK	OX	0	3	3	N/A	N/A				
117	090181	0500	4	4	LHR	LANDING	UNK	1		NO	N/A	N/A	UNK	OX	0	0	0	N/A	N/A				
117	090181	0500	4	2	LHR	LANDING	UNK	1		NO	N/A	N/A	UNK	OX	0	0	0	N/A	N/A				
117	090181	0500	4	1	LHR	LANDING	UNK	1		NO	N/A	N/A	UNK	OX	0	3	3	N/A	N/A				
118	090281	0000	2	0	FCD	TAXI	UNK	1		NO	N/A	N/A	UNK	OX	0	0	0	N/A	N/A				
119	090581	0000	2	3	BOM	TO	UNK	2		NO	YES	N/A	UNK	OX	0	0	0	N/A	N/A				
120	090681	0000	4	4	RXX	UNK	VFR	2		NO	YES	N/A	NO	OX	0	1	32	N/A	N/A				
121	090781	0000	2	3	TUL	TO	VFR	1		NO	N/A	N/A	UNK	222	94	1	16	N/A	N/A				

POMP
LOSS COMT IFSD BIRD 8 AV PI- SIGNI-
/REF DAMG REASON SEEN SPECIES 9 41 LOT FICANT
0 32 ACT REASON

RETR	DATE	TIME	C	A	ENG	POS	FLIGHT	ARRPT	PHASE	WE	DAMAGE	LOSS	COMT	IFSD	BIRD	8	AV	PI-	SIGNI-
122	090881	0000	2	3	KAN	LANDNG	VFR	1	NO	N/A	N/A	UNK	OK	0	0	0	0	N/A	N/A
122	090881	0000	2	1	KAN	LANDNG	VFR	2	NO	YES	N/A	UNK	OK	0	0	0	0	N/A	N/A
123	090881	0847	7	3	PHL	APPRCH	VFR	79	NO	YES	N/A	YES	2J	30	1	112	N/A	N/A	N/A
124	091181	0000	2	3	LGW	LANDNG	VFR	1	NO	N/A	N/A	UNK	OK	0	0	0	0	N/A	N/A
125	091181	0900	4	2	FZ2	TO	VFR	4	NO	YES	N/A	NO	OK	0	1	0	N/A	N/A	N/A
126	091281	1045	4	2	DEL	LANDNG	VFR	4559	YES	NO	MT	FGT	YES	3K	46	1	176	N/A	TRVSTRAC
127	091281	1730	2	3	LAX	TO	UNK	2	NO	YES	N/A	NO	OK	0	1	0	N/A	N/A	N/A
128	091581	0000	7	1	ATL	CLIMB	VFR	29	YES	YES	OTHER	YES	3K179	1	40	ATB	N/A	N/A	N/A
129	091681	1400	2	3	LAX	TO	UNK	20	YES	YES	VIBES	UNK	2P	9	1	11	ATB	N/A	N/A
130	091581	0000	3	1	MYB	TO	VFR	2	YES	YES	N/A	UNK	OK	0	0	0	0	ATB	N/A
131	091581	0500	7	1	LHR	LANDNG	VFR	2	NO	YES	N/A	UNK	14N	36	1	15	N/A	N/A	N/A
132	091781	0000	3	1	ATM	TO	VFR	1	NO	N/A	N/A	UNK	OK	0	0	0	0	N/A	N/A
133	091781	0700	4	2	JFK	APPRCH	UNK	49	NO	YES	N/A	YES	14N	14	1	20	N/A	N/A	N/A
134	091881	1830	4	4	FUK	UNK	UNK	1	NO	N/A	N/A	NO	14N	10	1	20	N/A	N/A	N/A
135	092181	0000	3	1	MYB	TO	VFR	1	NO	N/A	N/A	UNK	3K	28	1	28	N/A	N/A	N/A
136	092281	1230	7	3	KFO	UNK	VFR	1	NO	N/A	N/A	UNK	OK	0	1	0	N/A	N/A	N/A

DATA RECORDED & PROCESSED AT FAA TECHNICAL CENTER ATLANTIC CITY AIRPORT, N.J. ORZLNS ON 07/10/84 G PRINGS ACT-320 UNIT 6 PAGE 11																		
EVTR	DATE	TIME	C	A	ENG	POS	FLIGHT	ADPT	PHASE	UN	DAMAGE	LOSS	CONT	IFSD	BIRD	BIRD	PI- SIGNI-	
																	WT LOST FICANT	
																	ACT REASON	
137	092381	0000	3	-	2		LGA	LANDNG	VFR	2	NO	YES	N/A	UNK	14N	14	1	32 N/A N/A
138	092381	0942	7		1		ENQ	TO	VFR	1	NO	N/A	N/A	YES	3K	29	1	32 N/A N/A
139	092381	2400	4		1		PCO	TO	UNK	1	NO	N/A	N/A	UNK	0X	0	0	ATO N/A
140	092681	1345	4		3		XFO	UNK	VFR	1	NO	N/A	N/A	NO	11	50	1	14 N/A N/A
141	092781	0030	2		1		PCO	TAXI	UNK	1	NO	N/A	N/A	UNK	14N	17	1	28 N/A N/A
142	092781	0000	1		1		PUS	LANDNG	VFR	2	NO	YES	N/A	UNK	0X	0	0	N/A N/A
143	092781	1350	4		2		YMX	LANDNG	UNK	1	UNK	N/A	N/A	NO	0X	0	0	N/A N/A
144	092981	1100	4		3		YYZ	LANDNG	UNK	4	NO	YES	N/A	NO	0X	0	1	0 N/A N/A
145	093081	0000	4		0		XXX	UNK	UNK	7	NO	YES	N/A	NO	0X	0	0	N/A N/A
146	093081	0600	3		1		MYD	LANDNG	VFR	2	NO	YES	N/A	UNK	3K	28	1	28 N/A N/A
***** SAMPLE SIZE FOR SEP 81 = 31 P STRIKES WITH DAMAGE = 17 Z = 54.839																		
147	100181	0000	4		4		CBG	TO	VFR	2	YES	YES	N/A	UNK	0X	0	0	N/A N/A
148	100381	0000	7		1		XXX	UNK	VFR	1	NO	N/A	N/A	NO	0X	0	1	0 N/A N/A
149	100481	0000	2		3		ZBN	TO	VFR	2	NO	YES	N/A	UNK	0X	0	0	N/A N/A
150	100481	0000	2		3		369	CLIMB	UNK	6789	YES	YES	STAL/SNG	YES	51	17	1	240 ATB IPNRLOSS
151	100581	0000	3		1		MYD	TO	VFR	2	NO	YES	N/A	UNK	3K	28	1	28 N/A N/A
152	100581	0000	7		1		LIM	CLIMB	UNK	1	NO	N/A	N/A	UNK	0X	0	0	N/A N/A

ENG POS FLIGHT ARPT PHASE WX DAMAGE /RED DAMG REASON SEEN SPECIES DZ ACT REASON
 LOSS CONT IPSD RIPO BIRD R WT LOT FICANT
 POUR
 SIGMI-
 AV PJ-
 R WT LOT FICANT
 DZ ACT REASON

153	100681	0000	4	3	WBO TO	UNK 7	NO	YES	STAL/SRG	UNK	3K 28	1	28	ATO	N/A
154	100681	0735	4	3	DEL LANDING	UNK 49	NO	YES	N/A	UNK	OX 0	0	0	N/A	N/A
155	100881	0000	3	2	ORY LANDING	IFR 1	NO	N/A	N/A	UNK	OX 0	0	0	N/A	N/A
156	100881	0000	2	3	WBO TO	UNK 59	YES	YES	N/A	UNK	3K 51	1	282	ATO	N/A
157	100881	1300	4	3	LAX TO	UNK 2	NO	YES	VIBES	UNK	2P 1	1	10	ATO	N/A
158	100981	0000	3	2	XFO UNK	UNK 1	NO	N/A	N/A	UNK	OX 0	0	0	N/A	N/A
159	101081	0000	3	2	JFK DESCNT	UNK 2	NO	YES	N/A	UNK	OX 0	0	0	N/A	N/A
160	101081	0200	4	2	WOM TO	UNK 1	NO	N/A	N/A	YES	3K 28	1	24	ATO	N/A
161	101081	1240	7	3	HGS LANDING	VFR 1	NO	N/A	N/A	YES	3K 28	1	28	N/A	N/A
162	101281	0000	2	3	XFO UNK	UNK 2	NO	YES	N/A	NO	OX 0	1	22	UNK	N/A
163	101281	0000	2	3	KAM LANDING	UNK 2	NO	YES	N/A	UNK	OX 0	0	0	N/A	N/A
164	101281	0000	7	3	WGO LANDING	VFR 2	NO	YES	N/A	NO	2P 9	1	10	N/A	N/A
165	101381	0000	3	1	ORY LANDING	IFR 1	NO	N/A	N/A	UNK	2P 9	1	11	N/A	N/A
166	101381	1622	4	4	VYZ APPROCH	VFR 4	NO	YES	N/A	NO	642 6A	1	5	N/A	N/A
167	101481	0000	3	2	XFO UNK	UNK 1	NO	N/A	N/A	UNK	OX 0	0	0	N/A	N/A
168	101581	0000	4	1	305 TO	VFR 2	YES	YES	N/A	UNK	14W 14	1	44	ATO	N/A

ENG DATE TIME C A ENG POS FLIGHT PHASE WE DAMAGE LOSS CONT ICSB BIRD WT SIGNI-
POUR
LOSS CONT ICSB BIRD WT SIGNI-
/RED BANG REASON SEEN SPECIES 0 0Z ACT REASON

160	101601	0700	3	1	0RY	LANDING	IFR 1	NO	YES	N/A	YES	2P	9	1	110	N/A	N/A
170	101701	0000	3	1	TUN	TO	VFR 2	YES	YES	N/A	UNK	0X	0	0	0	0	ATB N/A
171	102381	0700	4	1	XXX	UNK	UNK 1	NO	N/A	N/A	NO	14M	36	1	9	N/A	ENG MULT
173	102091	0700	4	2	XXX	UNK	UNK 1	NO	N/A	N/A	NO	14M	36	3	9	N/A	ENG MULT
172	102081	1745	4	4	MHD	TO	UNK 4	NO	YES	N/A	NO	2J	95	1	32	N/A	N/A
173	102181	0000	4	3	XFO	UNK	UNK 1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A
174	102181	0000	7	1	XFO	UNK	UNK 1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A
175	102191	0000	3	2	SXR	TAXI	VFR 2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A
176	102281	2050	4	1	YVR	APPROCH	UNK 7	NO	YES	N/A	UNK	2J	26	1	80	N/A	N/A
177	102381	0600	7	1	XXX	UNK	UNK 2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A
178	102391	0000	4	1	XFO	UNK	UNK 2	NO	N/A	N/A	UNK	2J	25	1	32	N/A	N/A
179	102391	0000	4	1	XFO	UNK	UNK 1	NO	N/A	N/A	NO	0X	0	1	0	N/A	N/A
180	102381	0850	4	4	MHD	CLIMB	VFR 45	NO	YES	N/A	NO	3K	28	1	32	N/A	N/A
181	102551	0000	7	1	MGS	LANDING	VFR 1	NO	N/A	N/A	YES	3K	28	1	280	N/A	N/A
182	102551	0000	4	2	XFO	UNK	UNK 1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A
183	102681	0000	2	1	JAW	TO	UNK 2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A

ENTRY	DATE	TIME	A	ENG	POS	FLIGHT	PHASE	WT	DAMAGE	LOSS	COMT	IFSD	BIRD	BIRD	SEEN	SPECIES	B	AV	PI-	SIGMI-
										/RED	DAMG	WASON					D	WT	LOT	FICANT
																	OZ			REASON
184	102651	0000	7	2	XFO	UNK	UNK	2	NO	YES	N/A	NO	OK	0	0	0	0	0	0	N/A
185	102651	0000	3	2	CCU	TO	VFR	2	YES	YES	N/A	UNK	OK	0	0	0	0	0	0	ATO
186	102631	0500	4	4	JFK	UNK	IFR	1	NO	N/A	N/A	NO	14N	14	1	40	N/A	OTHER		
187	102831	0000	2	3	DPS	TO	UNK	1	NO	N/A	N/A	UNK	OK	0	0	0	0	0	0	N/A
188	102881	0000	4	4	GIG	DESCENT	VFR	2	NO	YES	N/A	UNK	2J	84	1	32	N/A	N/A		
189	103081	0000	7	3	XXX	UNK	UNK	7	NO	YES	N/A	UNK	14N	12	1	18	N/A	N/A		
190	103081	1230	4	3	FUK	TO	UNK	4	UNK	YES	N/A	NO	16N	10	1	26	N/A	N/A		
191	103301	1500	7	3	MES	TO	VFR	20	YES	YES	N/A	YES	3K	28	1	280	ATO	N/A		
192	103181	1125	4	4	SFO	CLIMB	UNK	1	NO	N/A	N/A	YES	2J	65	1	32	N/A	N/A		
***** SAMPLE SIZE FOR OCT 81 = 46 # STRIKES WITH DAMAGE = 2R Z = 60.870																				
193	110181	0000	4	1	XXX	UNK	UNK	2	NO	YES	N/A	UNK	OK	0	0	0	0	0	0	N/A
194	110381	0000	4	2	MKG	TO	UNK	2	YES	YES	N/A	NO	3K	28	1	32	N/A	N/A		
195	110381	0000	3	1	DBT	LANDING	IFR	1	NO	N/A	N/A	UNK	2P	9	1	110	N/A	N/A		
196	110481	0000	3	1	MRS	LANDING	IFR	1	NO	N/A	N/A	UNK	OK	0	0	0	0	0	0	N/A
197	110581	0000	3	2	MND	APPROCH	UNK	2	NO	YES	N/A	UNK	OK	0	0	0	0	0	0	N/A
198	110681	0000	3	1	MYB	TO	VFR	469	YES	YES	N/A	UNK	OK	0	0	0	0	0	0	ATO
199	110781	0000	7	1	XXX	UNK	UNK	89	NO	YES	N/A	NO	14N	14	1	44	N/A	N/A		

DATA RECORDED & PROCESSED AT FAA TECHNICAL CENTER, ATLANTIC CITY AIRPORT, N.J. ORGNS ON 07/16/84 G FRINGS ACT-320 UNIT 6 PAGE 15

DATA	DATE	TIME	C	ENG	POS	FLIGHT	ABPT	PHASE	WE	DAMAGE	LOSS	CONT	IFSD	BIRD	0	MT	LOT	SIGNT	AV	PI-	SIGNT
200	110801	0000	3	2	LPA	TO	VFR	2	YES	YES	N/A	YES	14N	36	1	10	ATO	N/A			
201	111201	0000	4	2	XFO	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A			
202	111181	0815	4	2	MUM	CLIMB	VFR	34589	YES	YES	HI	EGT	YES	2J	84	2	45	ATB	ODS	MULT	
203	111381	1700	7	1	VVR	APPRCH	VFR	1	UNK	N/A	N/A	YES	14N	14	1	34	N/A	N/A			
204	111491	0000	3	1	NAA	TO	VFR	2	YES	YES	VIBES	UNK	0X	0	0	0	ATB	N/A			
205	111581	1430	4	3	OSA	CLIMB	UNK	4	UNK	YES	N/A	NO	0X	0	0	0	N/A	N/A			
206	111781	2000	7	1	FUK	TO	UNK	2	NO	YES	N/A	UNK	0X	0	1	0	N/A	N/A			
207	112081	0000	2	3	IST	TO	UNK	20	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A			
208	112181	0000	4	1	AMS	TO	UNK	7	YES	YES	STAL/SRG	NO	14N	14	1	40	N/A	ALQURINT			
209	112281	0000	4	2	XFO	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A			
210	112381	0000	4	1	SMN	TO	UNK	2	UNK	YES	N/A	UNK	0X	0	1	15	N/A	N/A			
211	112481	0000	4	4	XFO	UNK	UNK	2	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A			
212	112481	0000	4	2	XFO	UNK	UNK	1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A			
213	113081	0000	4	3	XXX	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A			
214	113091	1400	4	2	VIE	TO	VFR	458	YES	NO	PARANTRS	UNK	222	84	1	14	N/A	TOUSPRAC			
***** SAMPLE SIZE FOR NOV 81 = 22 # STRIKES WITH DAMAGE = 15 Z = 68.182																					
215	120281	1330	7	2	VYC	APPRCH	VFR	1	NO	N/A	N/A	YES	2J	84	1	56	N/A	N/A			

11

SIGNI-
FICANT
REASON

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JUN 15 1964

LOS ANGELES

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DATA RECORDED & PROCESSED AT FAA TECHNICAL CENTER, ATLANTIC CITY AIRPORT, N.J. ORANS ON 07/16/84 G FRINGS ACT-320 UNIT 6 PAGE 18

***** SAMPLE SIZE FOR JAN 82 = 15 # STRIKES WITH DAMAGE = 15 Z = 86.667

242 020482 0000 2 3 JFE TO UNK 2 NO YES N/A UNK 14N 16 1 40 N/A N/A

249 020782 0000 4 1 XFO UNK UNK 1 NO N/A N/A NO 0X 0 1 0 N/A N/A

249 020882 0000 2 3 LOS CLIMB UNK 1 NO N/A N/A UNK 0X 0 0 0 N/A N/A

250 020982 1930 4 2 JMB TO UNK 49 UNK YES N/A UNK 0X 0 0 0 N/A N/A

251 021182 0000 4 1 OSA TO JFM 2 NO YES N/A UNK 14N 36 1 15 UNK N/A

252 021382 0000 4 1 XFO UNK UNK 47 NO YES N/A NO 14N 36 1 11 N/A N/A

253 021682 0000 4 4 MBO LANDING UNK 2 NO YES N/A UNK 0X 0 0 0 N/A N/A

254 022382 0000 3 1 DUB TO VFR 29 YES YES N/A UNK 0X 0 0 0 ATO N/A

255 022882 0000 4 1 XFO UNK UNK 2 NO YES N/A MO 14N 36 1 10 N/A N/A

256 022882 1200 4 2 BRU TO UNK 4589 YES NO WT FGT YES 14N 36 4 11 ATO BBS MULT LPBLOSS

***** SAMPLE SIZE FOR FEB 82 = 30 # STRIKES WITH DAMAGE = 8 Z = 80.000

257 030282 0000 3 1 XFO UNK UNK 2 NO N/A N/A UNK 0X 0 0 0 N/A N/A

258 030382 0000 4 3 MMW APPROCH VFR 7 YES YES N/A NO 2J 30 1 80 N/A ENG MULT

258 030382 0000 4 4 MMW APPROCH VFR 1 NO N/A N/A NO 2J 30 1 80 N/A ENG MULT

259 030582 0000 2 1 MIA CLIMB UNK 2 YES YES N/A YES 14N 17 2 30 UNK N/A

260 030682 1200 4 1 SHN TO UNK 2 NO YES N/A NO 5N 1 1 80 N/A N/A

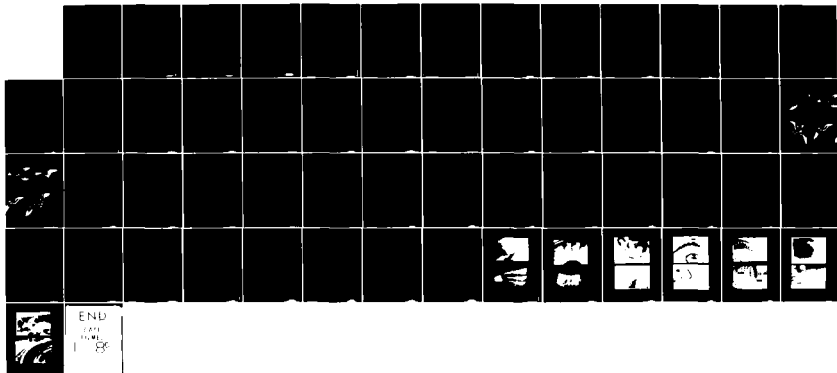
DA 147 852

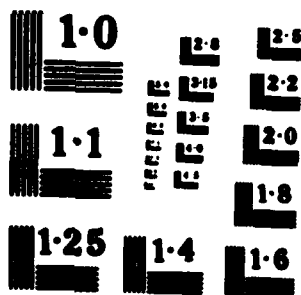
A STUDY OF BIRD INGESTIONS INTO LARGE HIGH BYPASS RATIO
TURBINE AIRCRAFT ENGINES(1) FEDERAL AVIATION
ADMINISTRATION TECHNICAL CENTER ATLANTIC CITY
G. FRINGS SEP 84 DOT/FAA/CT 84/13

2/2

1/6 1/2

III





[illegible]

ENG POS
A TIME C
FLIGHT
ARPT PHASE
W/DAMAGE
POUP
LOSS CONT
IFSD
BIRD
SPECIES
B/OZ
ACT
REASON
SIGNI-
B WT
LOT
FICANT

290	041382	1940	2	1	YYZ	TO	VFR	2	YES	YES	N/A	UNK	25124	1	12	ATB	N/A	
291	041582	0000	3	1	XUS	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	3	N/A	N/A	
292	041982	0000	7	1	XFO	UNK	UNK	9	NO	YES	N/A	NO	14W	22	1	52	N/A	N/A
293	042082	0000	3	2	XFO	UNK	VFR	1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A
294	042182	0000	3	1	XUS	UNK	UNK	2	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A
295	042182	1000	7	3	YYZ	TO	IFR	2	YES	YES	VIBES	YES	14W	12	1	18	ATB	N/A
296	042282	0000	4	1	TMR	LANDING	UNK	2	NO	YES	N/A	YES	0X	0	1	0	N/A	N/A
297	042482	0755	4	4	CPM	APPROCH	IFR	1	NO	N/A	N/A	YES	4W	1	1	16	N/A	ENG MULT
297	042482	0755	4	2	CPM	APPROCH	IFR	1	NO	N/A	N/A	YES	4W	1	2	16	N/A	ENG MULT ODS MULT
298	043082	0000	3	2	XFO	UNK	UNK	2	NO	N/A	N/A	NO	5W	1	1	10	N/A	N/A
299	043082	0000	4	4	XFO	UNK	UNK	1	NO	N/A	N/A	NO	14W	10	1	24	N/A	N/A
***** SAMPLE SIZE FOR APR 82 = 13 # STRIKES WITH DAMAGE = 9 Z = 69.231																		
300	050182	1000	4	3	SFO	APPROCH	UNK	1	NO	N/A	N/A	NO	0X	0	1	0	N/A	N/A
301	050282	0000	7	1	XFO	UNK	IFR	1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A
302	050282	0000	2	3	XEE	UNK	UNK	2	NO	YES	N/A	UNK	0X	0	1	0	N/A	N/A
303	050582	0000	3	1	NPL	TO	UNK	3	NO	YES	N/A	UNK	0X	0	1	0	N/A	N/A
304	050682	0000	4	3	XFO	UNK	UNK	2	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A

ENG POS A ENG POS FLIGHT PHASE WX DAMAGE /RED DAMG REASON IFSD BIRD SPECIES 0 02 ACT SIGNI-
EVTB DATE TIME C POS

305 050682 1300 4 2 LHR TO VFR 2 YES YES PARANTR NO 2J 84 1 40 ATB N/A

306 050782 0000 4 2 HRC TO UNK 7 UNK YES N/A NO 0X 0 0 0 ATO N/A

307 050782 1430 4 3 HRC APPROCH IFR 7 UNK YES N/A YES 2K 1 1 72 N/A N/A

308 050882 0000 4 4 HXX UNK UNK 1 NO N/A N/A NO 14N 36 1 15 N/A N/A

309 050982 0000 4 2 XFO UNK UNK 1 NO N/A N/A NO 172 54 3 1 N/A N/A

310 051082 0400 4 2 XUS UNK UNK 1 NO N/A N/A NO 14N 14 1 40 N/A N/A

311 051182 1355 4 4 TPE TO UNK 1 NO N/A N/A YES 0X 0 0 0 N/A N/A

312 051782 0000 3 1 XFO UNK UNK 1 NO N/A N/A NO 0X 0 0 0 N/A N/A

313 051982 0000 2 3 XUS UNK UNK 1 NO N/A N/A NO 0X 0 0 0 N/A N/A

314 051982 0000 7 1 XFO UNK UNK 2 NO YES N/A NO 0X 0 0 0 N/A N/A

315 052482 0000 4 4 XFO UNK VFR 2 NO YES N/A NO 3K 28 1 24 N/A N/A

316 052682 1630 4 2 SYB TO VFR 2 YES YES N/A YES 14N 32 2 11 N/A ENG MULT
BDS MULT

316 052682 1630 4 4 SYB TO VFR 2 YES YES N/A YES 14N 32 2 31 N/A ENG MULT
BDS MULT

316 052682 1630 4 3 SYB TO VFR 2 NO YES N/A YES 14N 32 2 11 N/A ENG MULT
BDS MULT

317 052782 0000 3 2 XFO UNK UNK 2 NO YES N/A NO 0X 0 0 0 N/A N/A

318 052982 0000 4 3 XFO UNK UNK 1 NO N/A N/A NO 0X 0 0 0 N/A N/A

ENG POS FLIGHT PHASE UN DAMAGE LOSS COMT IFSD BIRD BIRD # AV PI- SIGHT-
 EUTB DATE TIME C POS APT PHASE UN DAMAGE LOSS COMT IFSD BIRD BIRD # AV PI- SIGHT-
 REASON

319 052982 0000 3 1 DDB TO UNK 279 UNK YES N/A UNK 3K 28 1 24 N/A N/A

320 052982 0730 4 1 SYD APPROCH IFR 1 NO N/A N/A YES 14N 3A 1 110 N/A N/A

321 052982 0745 4 4 SYD TO IFR 1 NO N/A N/A YES 14N 3A 1 110 N/A N/A

322 052982 2235 4 3 TSV TO UNK 2 YES YES VIBES YES 0X 0 0 0 ATB N/A

323 053082 0615 2 1 LME CLIMB UNK 2 YES YES VIBES UNK 0X 0 0 0 ATB N/A

324 053082 2356 7 3 JPK TO VFR 450 YES YES VIBES YES 14N 21 1 560 ATB N/A

325 053182 0000 3 1 ORY CLIMB VFR 2 YES UNK N/A UNK 0X 0 0 0 ATB N/A

326 053182 0000 7 1 XFO UNK UNK 1 NO N/A N/A NO 0X 0 0 0 N/A N/A

***** SAMPLE SIZE FOR MAY 82 = 27 # STRIKES WITH DAMAGE = 15 Z = 55.556

327 060282 0000 3 2 CAG LANDING IFR 1 NO N/A N/A UNK 222 94 1 20 N/A N/A

328 060482 0000 3 1 XFO UNK UNK 1 NO YES N/A NO 0X 0 1 20 N/A N/A

329 060582 0000 4 2 HGO TO UNK 1 NO N/A N/A YES 0X 0 1 0 N/A N/A

330 060682 0000 7 3 XFO UNK UNK 1 NO N/A N/A NO 0X 0 0 0 N/A N/A

331 061082 0000 4 4 CAG TO UNK 29 YES UNK N/A UNK 0X 0 0 0 ATB N/A

332 061182 0000 3 2 ORY LANDING VFR 2 NO YES N/A UNK 0X 0 0 0 N/A N/A

333 061282 2000 7 3 XXX UNK UNK 1 YES N/A VIBES NO 0X 0 1 0 N/A N/A

334 061682 0000 3 1 LVS LANDING UNK 29 NO YES N/A UNK 3K 28 1 24 N/A N/A

REF ID: A7782
 DATE: 061782
 TIME: 0000
 3
 1
 335 061782 0000 3
 1
 336 061782 0000 2
 3
 337 061802 0000 2
 3
 338 062482 0000 3
 1
 339 062582 0000 3
 1
 340 062782 0000 1
 6
 341 062882 0000 7
 3
 342 062982 0000 2
 3
 343 063082 0000 3
 2
 344 070082 0000 4
 1
 345 070082 0000 3
 1
 346 070782 0000 7
 3
 347 070782 0000 1
 3
 348 070982 0000 3
 2
 349 070982 0000 2
 2
 350 070982 0000 2
 2

REF ID	DATE	TIME	UNIT	FLIGHT	PHASE	WIND	DAMAGE	LOSS	CONT	IFSD	BIRD	WT	LOT	SIGNI-			
335	061782	0000	3	1	WFO	UNK	UNK 2	NO	YES	N/A	NO	2P	9	1	11	N/A	N/A
336	061782	0000	2	3	WFO	UNK	UNK 9	NO	YES	N/A	UNK	0x	0	0	0	N/A	N/A
337	061802	0000	2	3	SSA	TO	UNK 2	YES	YES	VIPES	UNK	6N	50	1	13	ATO	N/A
338	062482	0000	3	1	ORV	LANDING	UNK 1	NO	N/A	N/A	UNK	0x	0	1	0	N/A	N/A
339	062582	0000	3	1	ORV	UNK	UNK 1	NO	N/A	N/A	UNK	0x	0	1	0	N/A	N/A
340	062782	0000	1	6	ORV	TO	UNK 2	NO	YES	N/A	UNK	2P	9	1	11	N/A	N/A
341	062882	0000	7	3	XFO	UNK	UNK 1	NO	N/A	N/A	NO	0x	0	0	0	N/A	N/A
342	062982	0000	2	3	XFO	UNK	UNK 2	UNK	YES	N/A	UNK	0x	0	0	0	ATO	N/A
343	063082	0000	3	2	XFO	UNK	UNK 1	NO	N/A	N/A	UNK	0x	0	1	0	N/A	N/A
***** SAMPLE SIZE FOR JUN 82 = 17 # STRIPS WITH DAMAGE = 2 Z = 47.859																	
344	070082	0000	4	1	FOR	APPCH	UNK 4	UNK	YES	N/A	UNK	0x	0	0	0	N/A	N/A
345	070082	0000	3	1	XFO	UNK 2	UNK 2	NO	N/A	N/A	NO	0x	0	0	0	N/A	N/A
346	070782	0000	7	3	ORV	TO	UNK 39	YES	YES	VIPES	UNK	0x	0	0	0	ATO	N/A
347	070782	0000	1	3	FOR	APPCH	UNK 76	NO	YES	N/A	NO	2P	9	2	12	N/A	863
348	070982	0000	3	2	WCE	LANDING	UNK 2	NO	YES	N/A	UNK	0x	0	0	0	N/A	N/A
349	070982	0000	2	2	XFO	UNK	UNK 2	UNK	YES	N/A	UNK	2P	1	1	12	N/A	N/A

ENTRY	DATE	TIME	A	ENG POS	FLIGHT ACFT PHASE	WZ	DAMAGE	POUR LOSS CONT /RED DANG	IFSD REASON	BIRD SEEN SPECIES	# WT LOT	PI- LOT ACT	SIGNI- FICANT REASON			
351	071102	0000	3	2	TLS TO	UNK 2	YES	YES	N/A	UNK	01	0	0	N/A	N/A	
352	071102	0000	3	2	TLS LANING	UNK 1	NO	N/A	N/A	UNK	1818N	1	28	N/A	N/A	
353	071102	1340	4	4	MEL CLIMB	UNK 45789	YES	YES	VIBES	UNK	2P	9	5	20	ATB ENG MULT BDS MULT	
353	071102	1340	4	3	MEL CLIMB	UNK 45789	YES	NO	INVULNTY	UNK	2P	9	4	20	ATB BDS MULT ENG MULT	
354	071102	1848	7	1	M65 APPROCH	IFB 1	N/A	N/A	N/A	YES	2J	95	1	30	N/A	N/A
355	071102	0000	4	2	REX UNK	UNK 2	NO	YES	N/A	NO	15	2	1	19	N/A	N/A
356	071102	0000	4	1	XFO UNK	UNK 1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A
357	071102	0000	4	1	REX UNK	UNK 2	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A
358	071102	0000	4	3	REX UNK	UNK 1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A
359	071102	2215	4	1	LAX TO	VFR 1	YES	N/A	N/A	NO	0X	0	1	6	N/A	N/A
360	071102	2230	4	4	CNG TO	UNK 29	YES	YES	VIBES	UNK	0X	0	0	0	ATB	N/A
361	071102	0000	4	4	DEL TO	UNK 7	UNK	YES	N/A	UNK	0X	0	0	0	ATO	IPURLOSS
362	071102	0000	4	2	XFO UNK	UNK 2	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A
363	071102	0000	4	4	XFO UNK	IFB 1	NO	N/A	N/A	NO	14N	10	1	20	N/A	N/A
364	071102	1800	4	3	XFO UNK	UNK 7	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A
365	072202	0000	4	4	SCL TO	UNK 2	YES	YES	N/A	UNK	2P106	1	5	N/A	N/A	N/A

ENG POS
FLIGHT PHASE
ARPT PHASE
DAMAGE
LOSS CONT
IFSD
BIRD
SEEN SPECIES
PI- SIGNI-
LOT
FICAM?

366 072282 0000 3 2 XFO UNK UNK 1 NO N/A N/A UNK 0X 0 1 0 N/A N/A

367 072282 0000 3 1 XFO UNK UNK 1 NO N/A N/A UNK 0X 0 0 0 N/A N/A

368 072282 1200 4 4 XFO UNK UNK 1 NO N/A N/A UNK 0X 0 0 0 N/A N/A

369 072282 3000 4 1 XFO UNK UNK 1 NO N/A N/A UNK 0X 0 0 0 N/A N/A

370 072282 0000 2 1 XFO UNK UNK 2 NO YES N/A UNK 0X 0 0 0 N/A N/A

371 072282 0000 4 3 XFO UNK UNK 1 NO N/A N/A UNK 0X 0 0 0 N/A N/A

372 072282 0000 4 1 ORV TO VFR 1 YES YES N/A UNK 0X 0 0 0 N/A N/A

373 072282 1500 4 2 KMI LANDING VFR 1 NO N/A N/A UNK 3X 51 1 192 N/A N/A

374 072282 0000 4 3 LMR TO UNK 2 NO YES N/A UNK 14M 36 1 10 N/A N/A

375 073082 0000 7 1 MKD TO UNK 29 YES YES N/A YES 0X 0 1 0 ATO N/A

376 073082 1700 2 3 ORD APPROCH UNK 1 NO N/A N/A UNK 0X 0 0 0 N/A BBS MULT

***** SAMPLE SIZE FOR JUL 82 = 33 # STRIKES WITH DAMAGE = 18 Z = 54.545

377 080182 0000 7 3 XXX UNK UNK 2 NO YES N/A UNK 14M 12 1 15 N/A N/A

378 080182 0000 4 1 XXX UNK UNK 2 NO YES N/A UNK 0X 0 0 0 N/A N/A

379 080282 0000 4 3 MKD UNK UNK 1 IFL 1 NO N/A N/A UNK 0X 0 0 0 N/A N/A

380 080282 1000 4 4 OSA LANDING IFR 7 NO YES N/A NO 2J 9L 1 32 N/A N/A

381 080382 1544 4 2 SEL APPROCH VFR 2 NO YES N/A YES 4L 16L 1 55 N/A N/A

POW
LOSS CONT IFSD BIRD B WT LOT SIGNI-
/RED DAMG REASON SEEN SPECIES D DT ACT FICANT

FLIGHT
ARRPT PHASE UNX DAMAGE

ENG
POS

A
TIME C

302	080482	0000	4	2	FCD	TO	UNK	6	YES	YES	N/A	UNK	14N	17	1	28	N/A	N/A
303	080482	0800	7	3	TUL	LANDING	VFR	1	NO	N/A	N/A	YES	14N	10	1	18	N/A	N/A
304	080582	0000	3	2	MCE	APPROCH	UNK	1	NO	N/A	N/A	UNK	14N	10	1	24	N/A	N/A
305	080882	0000	4	4	AMS	TO	UNK	29	YES	YES	VIPFS	UNK	0X	0	0	0	ATB	N/A
306	080882	0000	4	3	LSJ	TO	UNK	1	NO	N/A	N/A	UNK	0X	0	0	0	ATO	N/A
307	080882	0000	2	3	JFK	TO	UNK	478	YES	YES	VIBES	UNK	3K168	1	15	N/A	N/A	
308	081082	0000	3	2	KRI	TO	UNK	4	YES	YES	N/A	UNK	3K	28	1	24	ATB	N/A
309	081082	1230	4	3	FUR	TO	VFR	4	YES	YES	N/A	YES	0X	0	1	20	ATB	N/A
300	081182	0000	4	2	BOM	TO	UNK	2	YES	YES	N/A	UNK	0X	0	0	0	N/A	N/A
301	081282	1800	4	2	SYD	TO	VFR	490	YES	NO	VIBES	YES	2J	80	3	24	ATB	885 MULT
302	081582	0000	4	2	XFO	UNK	UNK	2	NO	YES	N/A	UNK	0X	0	1	0	N/A	N/A
303	081482	0000	3	2	FUR	APPROCH	UNK	2	NO	YES	N/A	UNK	61	21	1	0	N/A	N/A
304	081482	1500	7	3	VYZ	TO	VFR	279	YES	YES	VIBES	YES	2P	1	9	11	ATB	885 MULT
305	081782	0000	4	4	XFO	UNK	UNK	1	NO	N/A	N/A	NO	692124	2	1	N/A	885 MULT	
306	081782	0000	4	3	CPH	APPROCH	UNK	1	NO	YES	N/A	NO	5K	26	1	2	N/A	N/A
307	081882	0000	7	3	TUL	LANDING	VFR	1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A

EVENT	DATE	TIME	A	ENG	POS	FLIGHT	ARRT	PHASE	W	DAMAGE	LOSS	CONT	IFSD	BIRD	SEEN	SPECIES	B	AV	PI-	SIGNI-
	390	081002	1300	7	1	FUR	LANDING	VFR	2	NO	YES	N/A	YES	2P	9	1	13	N/A	N/A	
	399	082002	0000	2	1	460	LANDING	UNK	1	NO	N/A	N/A	UNK	0X	0	0	0	0	N/A	N/A
	400	082002	0000	7	3	LHR	CLIMB	UNK	459	YES	YES	VIRFS	UNK	14N	36	1	10	ATO	TRVS	NRAC
	401	082102	0000	3	2	XFO	UNK	UNK	1	NO	N/A	N/A	UNK	0X	0	1	0	N/A	N/A	
	402	082102	0000	4	3	XFO	UNK	UNK	1	NO	N/A	N/A	UNK	0X	0	1	0	N/A	N/A	
	403	082202	0000	3	2	XFO	UNK	VFR	2	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A	
	404	082402	2230	4	1	WDM	TO	UNK	1	YES	YES	N/A	NO	SM	25	2	6	ATO	BOS	MULT
	405	082602	0000	3	1	XFO	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A	
	406	082702	0000	3	2	GVA	TO	UNK	2	YES	YES	N/A	UNK	0X	0	0	0	N/A	N/A	
	407	082902	1715	4	2	FUR	TO	VFR	2	UNK	YES	N/A	NO	0X	0	0	0	N/A	N/A	
	408	083102	0000	7	3	XXX	UNK	UNK	7	NO	YES	N/A	NO	14N	14	1	36	N/A	N/A	
***** SAMPLE SIZE FOR AUG 82 = 32 # STRIKES WITH DAMAGE = 20 Z = 62,500																				
	409	090302	0000	2	1	JFE	TO	UNK	268	YES	YES	N/A	UNK	0X	0	0	0	ATO	N/A	
	410	090402	0000	4	6	XXX	UNK	UNK	6	N/A	YES	N/A	NO	0X	0	0	0	N/A	N/A	
	411	090402	1630	3	1	HCG	TO	VFR	459	YES	YES	VIRFS	YES	3K	28	2	36	ATO	N/A	
	412	090502	0000	2	1	XFO	UNK	UNK	26	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A	
	413	090502	1300	2	2	LGM	LANDING	UNK	1	NO	N/A	N/A	YES	14N	36	2	10	N/A	N/A	

EVTR	DATE	TIME	A	ENG POS	FLIGHT APPT PHASE	WZ	DAMAGE	LOSS CONT /RED DAMG	IFSD	BIRD SPECIES	BIRD COUNT	PI- LOT OZ	SIGMI- FICANT REASON
414	090782	0728	4		FCD	LANDING	UNK 1	NO	N/A	N/A	YES	14N 36	6 11 N/A BDS MULT
415	090892	1020	4	3	VVR	LANDING	UNK 1	NO	N/A	N/A	YES	0X 0	0 N/A ENG MULT
415	090882	1020	4		VVR	LANDING	UNK 1	NO	N/A	N/A	YES	0X 0	0 N/A ENG MULT
416	091082	0000	4	3	XFO	UNK	UNK 46	NO	YES	N/A	NO	0X 0	2 10 N/A BDS MULT
417	091182	0000	2	3	EUR	TO	VFR 2	YES	YES	VIBES	UNK	0X 0	0 0 ATB N/A
418	091282	0000	7	3	JFK	APPROCH	UNK 1	NO	N/A	N/A	NO	14N 14	1 47 N/A N/A
419	091332	1631	4		LUX	TO	UNK 43	YES	YES	VIBES	YES	2P 9	1 11 ATB N/A
420	091382	2350	4	3	AMS	CLIMB	VFR 2	YES	YES	N/A	UNK	0X 0	0 0 ATB N/A
421	091482	0000	2	1	XFO	UNK	UNK 1	NO	N/A	N/A	NO	0X 0	0 0 N/A N/A
422	091532	0940	4		MHP	TO	UNK 49	YES	YES	VIBES	NO	4L 44	2 16 N/A BDS MULT
423	091682	0450	4	1	DEL	APPROCH	IFR 2	NO	YES	N/A	NO	0X 0	0 0 N/A N/A
424	091782	1855	7	2	JFK	CLIMB	VFR 1	YES	N/A	VIBES	NO	0X 0	1 0 ATB N/A
425	091832	0000	4		LHR	TO	UNK 1	NO	N/A	N/A	NO	5M 1	1 8 N/A N/A
426	091982	0000	3	1	LGA	UNK	UNK 1	NO	N/A	N/A	UNK	0X 0	1 0 N/A N/A
427	092182	0000	7	1	XFO	UNK	UNK 2	NO	YES	N/A	NO	14N 36	1 11 N/A N/A
428	092232	1100	7	3	OSA	TO	VFR 1	NO	N/A	N/A	YES	2P 50	1 5 N/A N/A

PGWP
LOSS CONT IFSD BIRD B PT- SIGNI-
DAMAGE /RED DAMG REASON SEEN SPECIES D OZ ACT REASON

ENG POS
FLIGHT
ABPT PHASE BY

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429	092382	0000	2	1	RFO	UNK	UNK	1	NO	N/A	N/A	UNK	OX	0	1	0	N/A	N/A
430	092382	0000	4	4	RFO	UNK	UNK	1	NO	N/A	N/A	UNK	OX	0	1	0	N/A	N/A
431	092382	1025	4	4	DOM	TO	UNK	7	UNK	YES	N/A	NO	OX	0	1	0	ATO	N/A
432	092482	0000	2	3	ZRM	TO	IFR	29	NO	YES	VIRES	UNK	ICH	36	1	11	ATB	N/A
433	092582	0000	4	4	NUN	UNK	VFR	1	NO	N/A	N/A	UNK	SN	27	1	8	N/A	N/A
434	092782	0000	4	1	RFO	UNK	UNK	1	NO	N/A	N/A	NO	OX	0	1	0	N/A	N/A
435	092782	0000	4	3	RFO	UNK	UNK	1	NO	N/A	N/A	UNK	OX	0	1	0	N/A	N/A
436	092882	0000	4	4	DRY	LANDING	UNK	1	NO	N/A	N/A	UNK	OX	0	1	0	N/A	N/A
437	092882	0000	3	2	RFO	UNK	UNK	1	NO	N/A	N/A	UNK	OX	0	1	0	N/A	N/A
***** SAMPLE SIZE FOR SEP 82 = 29 # STRIKES WITH DAMAGE = 13 Z = 44.825																		
438	100182	0000	7	1	DUS	TO	VFR	3	YES	YES	VIRES	YES	SK	54	1	24	ATO	N/A
439	100182	2100	4	3	AUM	APPROCH	VFR	1	YES	N/A	N/A	NO	SN	27	1	9	N/A	N/A
440	100282	0000	4	3	RFO	UNK	UNK	1	NO	N/A	N/A	UNK	OX	0	1	0	N/A	N/A
441	100282	0000	3	2	PEM	LANDING	UNK	2	NO	YES	N/A	UNK	OX	0	1	0	N/A	N/A
442	100482	0000	7	1	XXX	UNK	UNK	9	NO	YES	N/A	NO	OX	0	0	0	N/A	N/A
443	100482	0000	4	3	RFO	UNK	UNK	1	NO	N/A	N/A	UNK	OX	0	1	0	N/A	N/A
444	100882	0000	4	3	XXX	UNK	VFR	1	NO	N/A	N/A	NO	OX	0	0	0	N/A	N/A

ENG POS A TIME C DATE
 LOSS CONT IFSD BIRD BIRD B AV PL- SIGNI-
 /RFD DRAG REASON SEEN SPECIES O OZ ACT REASON

476	111082	0000	2	ALG	LANDNG	UNK	2	NO	YES	N/A	UNK	0X	0	1	0	N/A	N/A
477	111082	0000	2	TRV	TO	VFR	2	YES	YES	N/A	UNK	0X	0	1	0	N/A	N/A
478	111292	0000	6	TUL	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	1	0	N/A	N/A
479	111292	0000	2	ORY	LANDNG	UNK	1	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A
480	111292	0000	4	XFO	UNK	UNK	28	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A
481	111292	0705	4	ABL	LANDNG	VFR	1	NO	N/A	N/A	YES	14N	36	2	10	N/A	BDS MULT
482	111482	0925	4	BUR	TO	UNK	48	YES	YES	N/A	UNK	3K	28	2	26	ATB	N/A
483	111582	1730	2	HLP	APPRCH	VFR	1	NO	N/A	N/A	YES	692104	1	1	N/A	N/A	
484	111682	0000	4	XFO	UNK	UNK	2	NO	YES	N/A	NO	0X	0	1	0	N/A	N/A
485	111692	0000	4	XFO	UNK	UNK	1	NO	N/A	N/A	NO	0X	0	1	0	N/A	N/A
486	111682	0000	1	XUS	UNK	UNK	2	NO	YES	N/A	NO	0X	0	1	0	N/A	N/A
487	111892	0820	4	ZRM	TO	UNK	2	YES	YES	INVLTRY STAL/SRG	UNK	14N	36	6	13	N/A	ENG MULT BDS MULT
487	111982	0820	4	ZRM	TO	UNK	4	YES	YES	VIRBS	UNK	14N	36	3	13	N/A	ENG MULT BDS MULT
488	111982	0000	2	IAM	TO	UNK	49	YES	YES	N/A	UNK	14N	12	1	14	ATB	N/A
489	111982	0000	7	SCO	TO	UNK	2	YES	YES	VIRBS	NO	0X	0	0	0	ATB	N/A
490	111992	1200	2	OAK	TO	VFR	279	YES	YES	N/A	UNK	1K	1	1	22	ATO	N/A

ENG POS A ENG POS LOSS CONT IFSD BIRD BIRD # AV PI- SIGNI-
ADMT PHASE DR DAMAGE /RED DAMG REASON SEEM SPECIES D OZ ACT PFCANT

491	112082	0000	7	3	MSY TO	VFR 4	NO	YES	N/A	YES	14N 12	1	15	N/A	N/A
492	112282	0000	4	3	RTO UNK	VFR 1	NO	N/A	N/A	NO	OK 0	7	0	N/A	N/A
493	112582	0000	3	2	NJA TO	UNK 2	YES	YES	N/A	UNK	2P105	1	6	ATB	N/A
494	112582	1330	4	1	DEL- CLIMB	UNK 408	YES	YES	STAL/SHG YES	1K 46	1	240	ATB	IPBLOSS	
495	112882	1813	2	1	MNB TO	VFR 49	YES	NO	VIBES	NO	11 57	1	51	ATB	AIRBURNT
496	112882	1855	4	3	MRT APPROCH	VFR 1	NO	N/A	N/A	NO	412279	1	3	N/A	N/A
497	113082	1300	7	3	VYX LANDING	IFR 1	NO	N/A	N/A	YES	OK 0	0	0	N/A	N/A
498	113082	1640	2	1	FOX TO	UNK 49	NO	YES	N/A	YES	2J115	1	24	N/A	N/A
***** SAMPLE SIZE FOR NOV 82 = 31 # STRIKES WITH DAMAGE = 21 Z = 67.742															
499	120182	0000	4	4	MBO TO	UNK 29	YES	YES	OTHER	UNK	OK 0	1	0	ATB	N/A
500	120282	1905	4	1	XFO UNK	VFR 1	NO	N/A	N/A	NO	14N 10	1	20	N/A	N/A
501	120342	0930	4	1	BOM TO	UNK 489	YES	YES	VIBES	UNK	3K 28	1	43	ATB	AIRBURNT
502	120482	0900	3	1	LME LANDING	VFR 1	NO	YES	N/A	UNK	222 94	1	32	N/A	ENG MULT
502	120482	0900	3	2	LME LANDING	VFR 2	NO	YES	N/A	UNK	222 94	1	32	N/A	ENG MULT
503	120482	1500	4	4	AMS TO	VFR 2	NO	YES	N/A	UNK	14N 26	9	8	ATO	ENG MULT
503	120482	1500	4	1	AMS TO	VFR 49	YES	UNK	N/A	UNK	14N 26	9	8	ATO	ENG MULT
503	120482	1500	4	2	AMS TO	VFR 2	NO	YES	N/A	UNK	14N 26	2	8	ATO	ENG MULT

POPP
LOSS CONT IFSD BIRD B AT PI- SIGMI-
DAMAGE FRED DANG REASON SEEN SPECIES D OZ ACT REASON

FLIGHT
ARPT PHASE

ENG
POS

DATE TIME C

504	120482	1823	4	3	VCP	TO	UNK 2	YES	YES	N/A	UNK	0X	0	1	24	N/A	N/A
505	120482	0000	2	1	1AM	APPRCH	UNK 2A	NO	YES	N/A	UNK	0X	0	1	0	N/A	N/A
506	120482	0000	4	4	XUS	UNK	UNK 1	YES	N/A	MI EGT	NO	0X	0	0	0	N/A	N/A
507	120482	0000	4	3	MEG	APPRCH	UNK 1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A
508	120882	1115	4	3	ORY	TO	IFR 2	NO	N/A	N/A	NO	14M	36	1	10	ATB	ENG MULT
508	120982	1115	4	2	ORY	TO	IFR 2	NO	YES	N/A	NO	14M	36	1	10	ATB	ENG MULT
509	120882	1530	4	3	LOS	TO	UNK 4589	YES	UNK	N/A	NO	14M	31	2	16	ATO	TRVSFRAC
510	120982	0000	4	3	QUM	UNK	IFR 1	NO	N/A	N/A	UNK	172	74	1	2	N/A	N/A
511	121082	0000	4	2	COG	CLIMB	UNK 2	NO	YES	N/A	NO	25124	1	17	N/A	N/A	
512	121082	0000	2	3	XFO	UNK	IFR 1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A
513	121082	0000	4	2	XFO	UNK	UNK 1	NO	N/A	N/A	NO	0X	0	0	0	N/A	N/A
514	121082	1010	4	2	WGO	TO	IFR 2	YES	YES	N/A	NO	3K180	1	28	UNK	N/A	
515	121582	0000	3	2	LVS	TO	UNK 2	NO	YES	N/A	UNK	3K	28	1	24	N/A	N/A
516	121882	0000	4	2	WBO	LANDING	UNK 1	NO	N/A	N/A	NO	0X	0	1	0	N/A	N/A
517	121982	0000	2	3	XFO	UNK	UNK 4	NO	YES	N/A	UNK	0X	0	1	0	N/A	N/A
518	121882	0700	4	4	KM	CLIMB	UNK 4B	UNK	NO	N/A	YES	3K	2A	1	28	N/A	AIRBRTMY

POUP
LOSS CONT IFSD BIRD BIRD B PL- SIGNI-
/RED DAMG REASON SEEN SPECIES D AT LOT PLACMT
REASON

FLIGHT
ARRPT PHASE UN DAMAGE

EMG
POS

565 022483 0000 2 3	RFO	UNK	UNK 1	NO	N/A	N/A	NO	0X 0	0	0	N/A	N/A
566 022483 0000 2 1	RFO	UNK	UNK 2	NO	YES	N/A	NO	0X 0	0	0	N/A	N/A
567 022583 0000 8 2	FLS	TO	UNK 1	NO	N/A	N/A	NO	5N 1	4	10	N/A	BDS MULT
568 022683 1500 4 2	LVS	TO	UNK 47	NO	YES	N/A	YES	5N 1	1	8	N/A	N/A
569 022983 0000 4 3	GUM	TO	UNK 27	UNK	YES	N/A	UNK	5N 25	1	7	N/A	N/A
570 022983 0000 4 3	RFO	UNK	UNK 1	NO	N/A	N/A	UNK	14N 35	1	13	N/A	N/A
***** SAMPLE SIZE FOR FEM 83 = 24 # STRIKES WITH DAMAGE = 17 Z = 70.833												
571 030583 0000 4 1	UNE	UNK	UNK 1	NO	N/A	N/A	NO	0X 0	0	0	N/A	N/A
572 030683 1230 4 4	YNL	LANDING	VFR 2	NO	YES	N/A	UNK	2P 9	1	10	N/A	N/A
573 030783 0000 4 1	RUS	UNK	UNK 1	NO	N/A	N/A	NO	14N 12	1	18	N/A	N/A
574 030783 1400 4 1	TLV	LANDING	VFR 2	UNK	YES	N/A	YES	14N 36	1	11	N/A	N/A
575 030783 1500 3 1	ORY	TO	UNK 2	YES	YES	VIRFS	UNK	0X 0	0	0	ATO	N/A
576 030983 0018 2 1	AMS	CLIMB	VFR 2	NO	YES	N/A	UNK	0X 0	0	0	N/A	N/A
577 030983 0800 4 2	JFK	APPROCH	UNK 1	NO	N/A	N/A	YES	14N 14	1	40	N/A	N/A
578 031253 0000 2 1	NAD	DESCENT	UNK 1	NO	N/A	N/A	NO	0X 0	0	0	N/A	N/A
579 031183 0640 4 1	RFO	UNK	UNK 1	NO	N/A	N/A	NO	14N 14	1	36	N/A	N/A
580 031183 1445 3 2	NIA	LANDING	VFR 49	NO	YES	N/A	UNK	14N 12	1	15	N/A	N/A

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581	031783	0000	4	4	QUE TO	UNK 2	YES	YES	N/A	UNK	0X 0	0	0	0	N/A	N/A
582	031783	1930	4	1	JFK CLIMB	UNK 2	UNK	YES	N/A	UNK	14N 14	1	36	N/A	N/A	
583	031983	0000	4	2	XFO UNK	UNK 1	NO	N/A	N/A	NO	0X 0	0	0	0	N/A	N/A
584	032083	0000	4	4	XFO UNK	UNK 4	NO	YES	N/A	NO	14N 33	1	11	N/A	N/A	
585	032183	0000	2	1	LAD APPROCH	UNK 8	NO	YES	N/A	UNK	0X 0	0	0	0	N/A	N/A
586	032483	1100	2	3	CPH TO	JFR 45783	YES	UNK	VIBFS	YES	14N 16	2	14	ATB ENG MULT	BDS MULT	
586	032483	1100	2	1	CPH TO	JFR 27	UNK	YES	N/A	YES	14N 16	1	14	ATB ENG MULT		
587	032883	0100	4	4	JFK TO	UNK 45689	YES	NO	VIBFS	NO	2J R4	1	29	ATB TRVSBRAC	SPMBLOSS	
588	032983	0000	4	2	XFO UNK	UNK 2	NO	YES	N/A	NO	0X 0	0	0	0	N/A	N/A
589	032983	0000	7	2	XUS UNK	UNK 2	NO	YES	N/A	NO	0X 0	0	0	0	N/A	N/A
590	033083	0000	3	2	XFO UNK	UNK 7	NO	YES	N/A	NO	0X 0	0	0	0	N/A	N/A
591	033183	0000	2	1	FRA CLIMB	UNK 2	YES	YES	VIBFS	UNK	0X 0	0	0	0	ATB N/A	
592	033183	1420	4	4	AMS CLIMB	JFR 2	NO	YES	N/A	UNK	0X 0	0	0	0	ATB N/A	
***** SAMPLE SIZE FOR MAP 83 = 22 # STRIKES WITH DAMAGE = 16 Σ = 72.727																
593	033283	0620	4	1	LHR LANDING	UNK 1	NO	N/A	N/A	NO	0X 0	0	0	0	N/A	N/A
594	040483	0904	4	3	KMI TO	UNK 4	NO	YES	N/A	YES	1K 28	1	40	N/A	ENG MULT	
594	040483	0904	2	2	KMI TO	UNK 2	NO	YES	N/A	YES	1K 28	1	40	N/A	ENG MULT	

ENTR	DATE	TIME	A	ENG	POS	FLIGHT	ABDT	PHASE	WZ	DAMAGE	LOSS	CONT	IFSD	RIBD	BIRD	9	WT	LOT	PICANT	REASON	SPEN	SPECIES	D	CT	ACT	REASON	8	AV	PL-	SIGNI-	
595	040593	1735	4	1	RFO	TO	VFR	4	YES	YES	VIRFS	YES	3K168	1	19	ATO	N/A														
596	040683	0000	4	1	MVD	TO	UNK	2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A													
597	041383	0700	7	1	VUL	LANDING	VFR	1	NO	N/A	N/A	YES	0X	0	0	0	N/A	N/A													
598	041383	0700	4	1	HAW	APPRCH	UNK	1	NO	N/A	N/A	YES	5W	1	1	9	N/A	N/A													
599	041483	0000	7	1	XFO	UNK	UNK	0	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A													
600	041483	0000	7	1	XUS	UNK	UNK	1	NO	N/A	N/A	NO	14W	14	1	40	N/A	N/A													
601	041683	1300	7	1	VY2	LANDING	VFR	1	NO	N/A	N/A	YES	0X	0	0	0	N/A	N/A													
602	041783	0000	2	1	WEX	TO	VFR	1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A													
603	042083	0000	4	4	XFO	UNK	UNK	1	NO	YES	N/A	NO	0X	0	0	0	N/A	N/A													
604	042093	0000	3	2	TMR	LANDING	UNK	1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A													
605	042183	0000	3	2	XFO	UNK	UNK	1	NO	N/A	N/A	UNK	0X	0	0	0	N/A	N/A													
606	042283	0000	4	3	XFO	UNK	UNK	2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A													
607	042483	0000	2	1	LOS	CLIMB	UNK	2	NO	YES	N/A	UNK	0X	0	0	0	N/A	N/A													
608	042483	0130	6	1	VVR	LANDING	VFR	1	NO	N/A	N/A	YES	14W	10	1	24	N/A	N/A													
609	042983	1012	7	3	SFO	TO	VFR	270	YES	YES	N/A	YES	1K	1	1	72	ATO	AIRBURN													

***** SAMPLE SIZE FOR APR 83 = 17 8 STRIKES WITH DAMAGE = 7 2 = 41.176

610 050383 0000 7 3 XFO UNK UNK 7 NO YES N/A NO 0X 0 0 N/A N/A

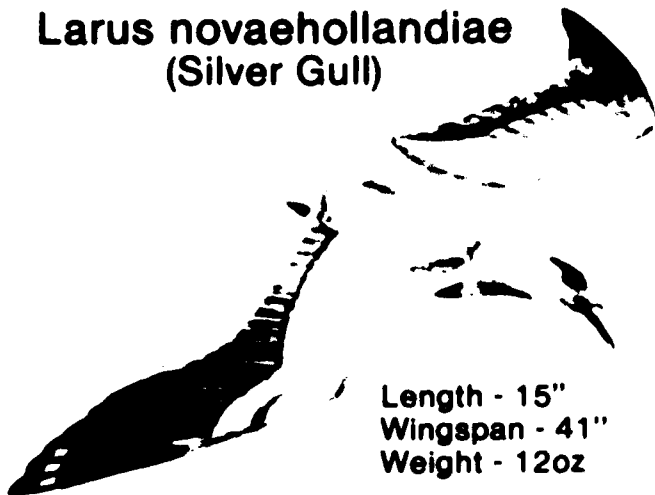
EWTD	DATE	TIME	A	ENG	POS	FLIGHT	ARRPT	PHASE	WE	SOURCE	LOSS	CONT	IFSD	BIRD	UIRD	3	41	LOT	SIGNI-

611	050483	0600	3	2		LME	TO	VFR	2	NO	YES	N/A	UNK	01	0	0	0	0	N/A	N/A
612	050483	0000	4	2		RRR	UNK	UNK	1	NO	N/A	N/A	NO	14N	14	1	32	N/A	N/A	
613	050283	0000	4	4		RFO	UNK	VFR	1	NO	N/A	N/A	NO	172	73	1	2	N/A	N/A	
614	051283	1210	4	3		DEA	TO	UNK	2	NO	YES	N/A	NO	01	0	1	24	N/A	N/A	
615	051483	0000	7	1		RUS	UNK	UNK	29	UNK	YES	N/A	NO	61	21	1	16	N/A	N/A	
616	051483	0000	3	2		MPL	APPRCH	UNK	1	NO	N/A	N/A	UNK	14N	36	1	12	N/A	N/A	
617	051483	0000	3	1		RFO	UNK	UNK	1	NO	N/A	N/A	NO	01	0	0	0	N/A	N/A	
618	051483	0000	4	1		ANC	TO	VFR	29	UNK	YES	N/A	UNK	2J	84	2	36	ATO	BDS	MULT
619	051483	0000	3	1		RFO	UNK	UNK	7	NO	N/A	N/A	UNK	01	0	0	0	N/A	N/A	
620	051883	1235	6	1		ROS	TO	VFR	2	N/A	YES	N/A	UNK	01	0	0	0	N/A	N/A	
621	052083	0000	8	2		FRA	TO	UNK	4789	YES	UNK	N/A	UNK	2P	9	2	18	ATB	BDS	MULT
622	052183	0000	3	2		RUS	UNK	UNK	1	NO	N/A	N/A	NO	01	0	0	0	N/A	N/A	
623	052483	1700	4	1		JNB	TO	UNK	2	YES	YES	N/A	UNK	3N	27	1	6	N/A	N/A	
624	052793	0000	7	2		RUS	UNK	UNK	1	NO	N/A	N/A	NO	2P105	1	4	N/A	N/A		
625	052783	1400	4	2		SVB	LANDNG	IFR	1	NO	N/A	N/A	YES	14N	32	1	12	N/A	N/A	
626	052893	0000	2	3		JFK	LANDNG	IFR	48	UNK	YES	N/A	UNK	14N	14	1	13	N/A	N/A	

APPENDIX F

MOST COMMONLY INGESTED BIRD SPECIES DRAWINGS

Larus novaehollandiae
(Silver Gull)



Length - 15"
Wingspan - 41"
Weight - 12oz

INGESTION LOCATION
Foreign - 5
US - 0
Unknown - 0

Larus crassirostris
(Black-Tailed Gull)



Length - 16"
Wingspan - 48"
Weight - 20oz

INGESTION LOCATION
Foreign - 14
US - 0
Unknown - 0

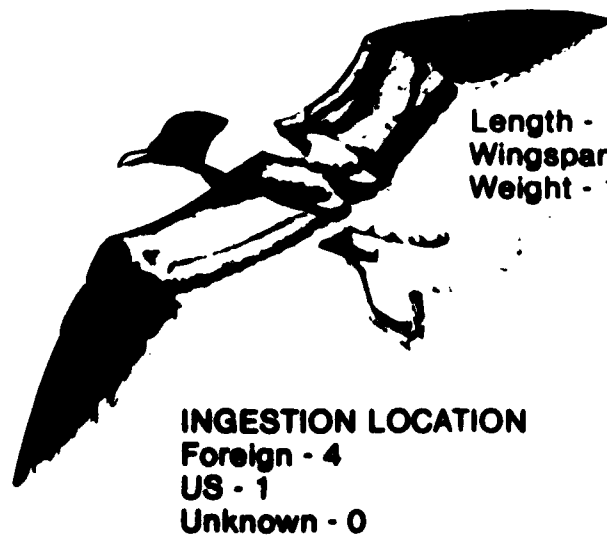
Larus ridibundus
(Common Black-headed Gull)



Length - 14"
Wingspan - 38"
Weight - 10oz

INGESTION LOCATION
Foreign - 30
US - 0
Unknown - 4

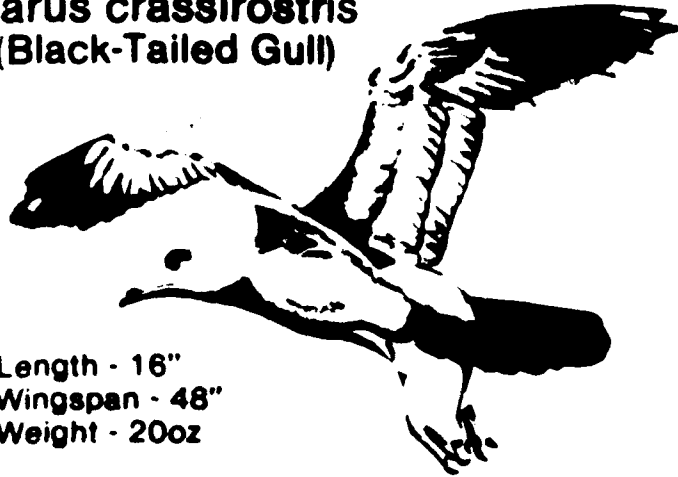
Larus atricilla
(Laughing Gull)



Length - 13"
Wingspan - 41"
Weight - 10oz

INGESTION LOCATION
Foreign - 4
US - 1
Unknown - 0

Larus crassirostris
(Black-Tailed Gull)

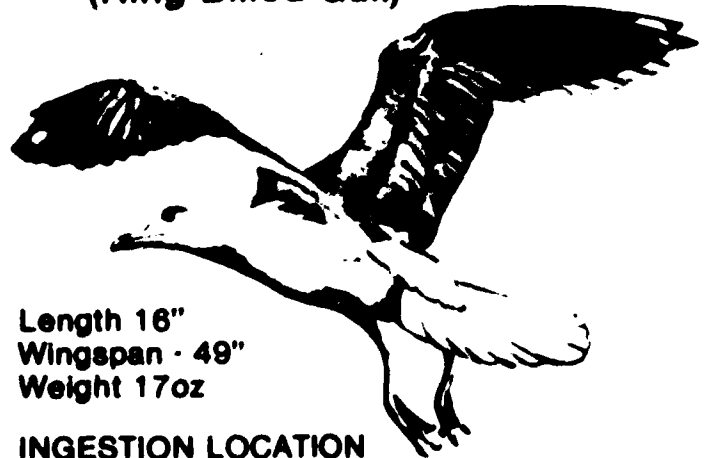


Length - 16"
Wingspan - 48"
Weight - 20oz

INGESTION LOCATION

Foreign - 14
US - 0
Unknown - 0

Larus delawarensis
(Ring-Billed Gull)



Length 16"
Wingspan - 49"
Weight 17oz

INGESTION LOCATION

Foreign - 1
US - 8
Unknown - 2

Larus atricilla
(Laughing Gull)

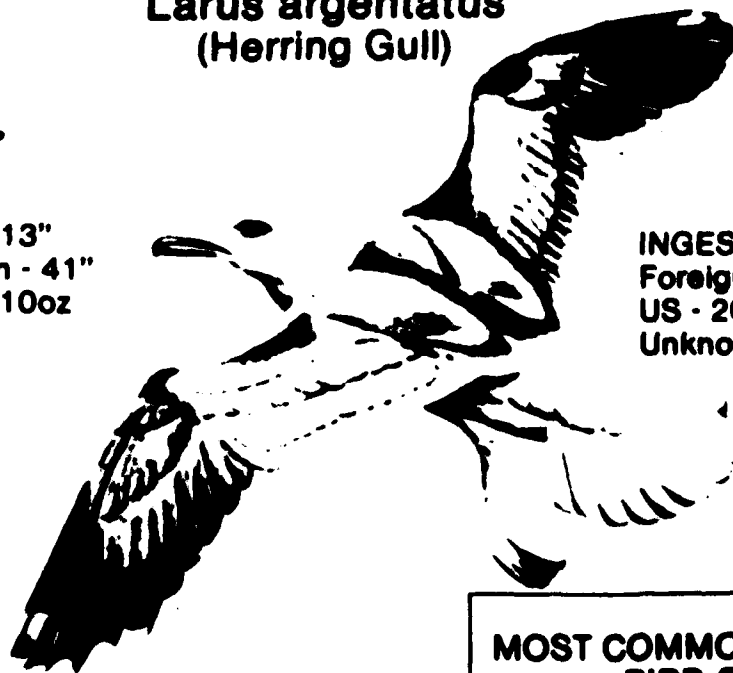


Length - 13"
Wingspan - 41"
Weight - 10oz

INGESTION LOCATION

Foreign - 4
US - 1
Unknown - 0

Larus argentatus
(Herring Gull)



Length - 20"
Wingspan - 55"
Weight - 36oz

INGESTION LOCATION

Foreign - 4
US - 20
Unknown - 3

**MOST COMMONLY INGESTED
BIRD SPECIES**

APPENDIX C
AIRPORT IDENTIFIERS

APPENDIX G

AIRPORT IDENTIFIERS

ABJ	Abidjan, Ivory Coast
ADL	Adelaide, S. Australia
ALG	Alamosa, Colorado, USA
AMM	Amman, Jordan
AMS	Amsterdam, Netherlands
ANC	Anchorage, Alaska, USA
ANU	Antigua, West Indies
ATH	Athens, Greece
ATL	Atlanta, Georgia, USA
AUH	Abu Dhabi, UA Emirates
BGF	Bangui, Cen. African Republic
BKK	Bangkok, Thailand
BNE	Brisbane, Australia
BOD	Bordeaux, France
BOM	Bombay, India
BOS	Boston, Massachusetts, USA
BRU	Brussels, Belgium
BWI	Baltimore, Maryland, USA
CAI	Cairo, Arab Republic of Egypt
CCU	Calcutta, India
CDG	Paris, France (Charles de Gaulle Airport)
CJU	Cheju, Republic of Korea
CPH	Copenhagen, Denmark
DEL	Delhi, India
DKR	Dakar, Senegal
DPS	Denpasar, India
DUR	Durban, South Africa
DUS	Dusseldorf, Republic of Germany
EBB	Entebbe/Kampala, Uganda
EWR	New York, NY-Newark Airport, USA
EZE	Buenos Aires, Arg.-Ezeiza Airport
FCO	Rome, Italy, L. DaVinci (Fium) Airport
FDF	Port de France, Martinique
FEZ	Fez, Morocco
FIH	Kinshasa, Zaire
FLL	Ft. Lauderdale/Hollywood, Florida, USA
FRA	Frankfurt, Republic of Germany
FUK	Fukuoka, Japan
GIG	Rio De Janeiro, Brazil International
GUM	Guam Island, Mariana Is.
GVA	Geneva, Switzerland
HAM	Hamburg, Republic of Germany
HKD	Hakodate, Japan
HKG	Hong Kong, Hong Kong

HLP	Jakarta, Indonesia - Halim Per A
HND	Tokyo, Japan - Haneda Airport
HYD	Hyderabad, India
IAD	Washington - Dulles Airport, USA
IAH	Houston, Texas - International Airport
IST	Istanbul, Turkey
JED	Jeddah, Saudi Arabia
JFK	New York, NY - Kennedy International Airport, USA
JNB	Johannesburg, South Africa
KAN	Kano, Nigeria
KHI	Karachi, Pakistan
KMQ	Komatsu, Japan
KRT	Khartoum, Sudan
KUL	Kuala Lumpur, Malaysia
LAX	Los Angeles, California, USA
LCA	Larnaca, Cyprus
LGA	Laguardia Airport, New York, USA
LGW	London, England, Gatwick Airport
LHE	Lahore, Pakistan
LHR	London, England, Heathrow Airport
LIM	Lima, Peru
LIN	Milan, Italy - Forlanini-Linate
LIS	Lisbon, Portugal
LOS	Lagos, Nigeria
LPA	Las Palmas, Canary Is.
LUX	Luxembourg, Luxembourg
LYS	Lyon, France
MAA	Madras, India
MAD	Madrid, Spain
MEL	Melbourne, Australia
MEX	Mexico City, Mexico
MGQ	Mogadishu, Somalia
MIA	Miami, Florida, USA
MNL	Manila, Philippines
MPL	Montpellier, France
MRS	Marseille, France
MSP	Minneapolis/St. Paul, Minnesota, USA
MSY	New Orleans, Louisiana, USA
MTY	Monterrey, Mexico
MVD	Montevideo, Uruguay
MWH	Moses Lake, Washington, USA
MXP	Milan, Italy - Malpensa Airport
NBO	Nairobi, Kenya
NCE	Nice, France
NGO	Nagoya, Japan
NGS	Nagasaki, Japan
NIM	Niamey, Niger

NKC	Nouakchott, Mauritania
NRT	Tokyo, Japan - Narita Airport
OAK	San Francisco, California - Oakland Airport, USA
OKA	Okinawa, Ryukyu Is., Japan
ORD	Chicago, Illinois, O'Hare Airport, USA
ORY	Paris, France, Orly Airport
OSA	Osaka, Japan
PDX	Portland, Oregon, USA
PEN	Penang, Malaysia
PHL	Philadelphia, Pennsylvania, USA
POS	Port of Spain, Trin. & Tob.
PTY	Panama City, Panama Republic
PUS	Pusan, Republic of Korea
SDL	Sundsvall, Sweden
SCQ	Santiago De Compostela, Spain
SEA	Seattle/Tacoma, Washington, USA
SEL	Seoul, Republic of Korea
SFO	San Francisco, California, USA
SID	Sal Island, Cape Verde, Is.
SIN	Singapore, Singapore
SNN	Shannon, Republic of Ireland
SSA	Salvador, Brazil
STR	Stuttgart, Republic of Germany
SUB	Surabaya, Indonesia
SXR	Srinagar, India
SYD	Sydney, NSW Australia
THR	Tehran, Islamic Republic of Iran
TLS	Toulouse, France
TLV	Tel Aviv - Yafu, Israel
TNR	Antananarivo, Dem. Rep. Madagascar
TPE	Taipei, Taiwan
TRV	Trivandrum, India
TSV	Townsville, Qld, Australia
TUL	Tulsa, Oklahoma, USA
TUN	Tunis, Tunisia
VCP	Seo Paulo, Brazil - Viracopos Airport
VIE	Vienna, Austria
WDH	Windhoek, Namibia
WLG	Wellington, New Zealand
XFO	Unknown Location, Foreign
XUS	Unknown Location, United States
XXX	Unknown Location, Worldwide

YMX	Montreal, Quebec - Mirabel International
YUL	Montreal, Quebec, Canada
YVR	Vancouver, B.C., Canada
YYC	Calgary, Alta., Canada
YYZ	Toronto, Ontario, Canada
ZRH	Zurich, Switzerland

APPENDIX H
EVENTS, OPERATIONS, AND RATES

AIRPORT: BIRDS INDESTRUCTION EVENTS, OPERATIONS AND INDESTRUCTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)								OVER-ALL
		1	2	3	4	5	6	7	8	
1	ABJ	EVENTS	0	1	0	0	0	0	0	1
		OPERATIONS	0	3340	04	040	0	0	0	4300
		RATE/10K	0.0	2.987	0.0	0.0	0.0	0.0	0.0	2.326
2	ADL	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	0	0	267	0	0	0	267
		RATE/10K	0.0	0.0	0.0	37.453	0.0	0.0	0.0	37.453
3	ALG	EVENTS	0	0	1	0	0	0	0	1
		OPERATIONS	0	0	5101	65	0	0	56	5222
		RATE/10K	0.0	0.0	1.960	0.0	0.0	0.0	0.0	1.915
4	AND	EVENTS	0	0	0	0	0	2	0	2
		OPERATIONS	0	505	1304	1631	0	0	2572	6091
		RATE/10K	0.0	0.0	0.0	0.0	0.0	7.776	0.0	3.204
5	ANS	EVENTS	0	2	0	8	0	0	0	10
		OPERATIONS	0	4925	630	11552	0	0	164	17279
		RATE/10K	0.0	4.061	0.0	6.925	0.0	0.0	0.0	5.787
6	ANC	EVENTS	0	0	0	2	0	0	0	2
		OPERATIONS	0	6700	0	15954	0	0	0	22734
		RATE/10K	0.0	0.0	0.0	1.254	0.0	0.0	0.0	0.880
7	AMJ	EVENTS	0	0	0	0	0	0	1	1
		OPERATIONS	0	660	409	460	0	0	1112	2641
		RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	8.993	3.786
8	ATW	EVENTS	0	0	1	0	0	0	0	1
		OPERATIONS	0	2347	12627	6424	0	0	1823	23221
		RATE/10K	0.0	0.0	0.792	0.0	0.0	0.0	0.0	0.431
9	ATL	EVENTS	0	0	0	0	0	0	2	2
		OPERATIONS	0	2067	9750	763	796	1518	49661	64514
		RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	0.403	0.319
10	AMH	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	1684	2866	5642	0	0	4300	14492
		RATE/10K	0.0	0.0	0.0	1.772	0.0	0.0	0.0	0.690

AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)								OVER-ALL
		1	2	3	4	5	6	7	8	
11	BOF	EVENTS	0	2	0	0	0	0	0	2
		OPERATIONS	0	323	0	0	0	0	0	323
		RATE/10K	0.0	61.919	0.0	0.0	0.0	0.0	0.0	61.919
12	BTK	EVENTS	0	1	0	0	0	0	0	1
		OPERATIONS	0	8234	9394	14900	0	86	4463	37101
		RATE/10K	0.0	1.211	0.0	0.0	0.0	0.0	0.0	0.270
13	BWE	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	489	1962	2631	0	0	0	5082
		RATE/10K	0.0	0.0	0.0	3.801	0.0	0.0	0.0	1.968
14	BOO	EVENTS	0	0	3	0	0	0	0	3
		OPERATIONS	0	228	3018	472	0	0	0	3718
		RATE/10K	0.0	0.0	9.940	0.0	0.0	0.0	0.0	0.049
15	BOW	EVENTS	0	1	2	9	0	0	2	14
		OPERATIONS	0	2734	10013	9637	0	0	3673	26062
		RATE/10K	0.0	3.638	1.997	9.339	0.0	0.0	3.445	3.372
16	BOS	EVENTS	0	0	0	1	0	1	0	2
		OPERATIONS	0	12419	10595	6456	89	443	14271	44272
		RATE/10K	0.0	0.0	0.0	1.549	0.0	22.573	0.0	0.432
17	BOW	EVENTS	0	1	0	2	0	0	0	3
		OPERATIONS	0	3426	0	2768	0	0	122	6316
		RATE/10K	0.0	2.919	0.0	7.225	0.0	0.0	0.0	4.750
18	BUI	EVENTS	0	1	0	0	0	0	0	1
		OPERATIONS	0	3480	926	0	0	61	217	4084
		RATE/10K	0.0	2.717	0.0	0.0	0.0	0.0	0.0	2.048
19	CAI	EVENTS	0	0	2	0	0	0	0	2
		OPERATIONS	0	1048	9761	5233	0	0	2823	18865
		RATE/10K	0.0	0.0	2.049	3.0	0.0	0.0	0.0	1.059
20	CCU	EVENTS	0	0	3	0	0	0	0	3
		OPERATIONS	0	150	3969	428	0	0	338	4885
		RATE/10K	0.0	0.0	7.339	0.0	0.0	0.0	0.0	6.141

AIRPORT: BIRDS INDESTRUCTION EVENTS, OPERATIONS AND INDESTRUCTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		----- AIRCRAFT TYPE -----								OVER-ALL
		1	2	3	4	5	6	7	8	
21	CDG	EVENTS	0	1	5	6	0	0	0	12
		OPERATIONS	0	4083	18939	15793	94	0	8146	47834
		RATE/10K	0.0	2.449	2.640	3.799	0.0	0.0	0.0	2.330
22	CJU	EVENTS	0	0	1	0	0	0	0	1
		OPERATIONS	0	0	1799	0	0	0	0	1799
		RATE/10K	0.0	0.0	5.339	0.0	0.0	0.0	0.0	5.339
23	CPH	EVENTS	0	1	0	3	0	0	0	4
		OPERATIONS	0	2628	1738	3237	88	0	140	7851
		RATE/10K	0.0	3.805	0.0	9.211	0.0	0.0	0.0	5.095
24	DEL	EVENTS	0	0	4	5	0	9	1	10
		OPERATIONS	0	1468	6749	7674	0	0	1299	17190
		RATE/10K	0.0	0.0	5.927	6.516	0.0	0.0	7.698	5.817
25	DKR	EVENTS	0	1	1	1	0	0	0	3
		OPERATIONS	0	1421	1482	954	0	0	0	3857
		RATE/10K	0.0	7.037	6.748	10.482	0.0	0.0	0.0	7.800
26	DPS	EVENTS	0	1	0	2	0	0	0	3
		OPERATIONS	0	3420	347	1973	0	0	0	5890
		RATE/10K	0.0	2.924	0.0	10.137	0.0	0.0	0.0	5.093
27	DUR	EVENTS	0	0	2	3	0	0	0	5
		OPERATIONS	0	0	6411	328	0	0	0	5739
		RATE/10K	0.0	0.0	5.120	91.463	0.0	0.0	0.0	8.712
28	DUS	EVENTS	0	0	0	0	0	0	1	1
		OPERATIONS	0	2397	1308	671	0	0	34	4430
		RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	185.185	2.257
29	EDB	EVENTS	0	1	0	0	0	0	0	1
		OPERATIONS	0	105	0	0	0	0	0	105
		RATE/10K	0.0	95.238	0.0	0.0	0.0	0.0	0.0	95.238
30	EUR	EVENTS	0	1	0	0	0	0	0	1
		OPERATIONS	0	19275	2845	1936	331	273	3498	21178
		RATE/10K	0.0	0.973	0.0	0.0	0.0	0.0	0.0	0.472

AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)								OVER-ALL
		1	2	3	4	5	6	7	8	
31	EZE									
	EVENTS	0	0	0	2	0	0	0	0	1
	OPERATIONS	0	2048	1261	4572	0	0	581	0	8412
	RATE/10K	0.0	0.0	0.0	4.374	0.0	0.0	0.0	0.0	2.378
32	FCB									
	EVENTS	0	3	1	4	0	0	0	0	8
	OPERATIONS	0	5344	10229	10094	88	0	1746	0	27561
	RATE/10K	0.0	5.614	0.978	3.963	0.0	0.0	0.0	0.0	2.909
33	FDF									
	EVENTS	0	0	0	1	0	0	0	0	1
	OPERATIONS	0	188	0	1527	0	0	9	0	1724
	RATE/10K	0.0	0.0	0.0	6.549	0.0	0.0	0.0	0.0	5.880
34	FEZ									
	EVENTS	0	0	0	1	0	0	0	0	1
	OPERATIONS	0	113	113	226	0	0	0	0	452
	RATE/10K	0.0	0.0	0.0	44.248	0.0	0.0	0.0	0.0	22.124
35	FIN									
	EVENTS	0	1	0	0	0	0	0	0	1
	OPERATIONS	0	2011	0	594	0	0	34	0	2739
	RATE/10K	0.0	4.973	0.0	0.0	0.0	0.0	0.0	0.0	3.651
36	FLL									
	EVENTS	0	0	0	0	0	0	1	0	1
	OPERATIONS	0	1385	2987	0	91	0	9024	0	13486
	RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	1.108	0.0	0.742
37	FRA									
	EVENTS	0	1	0	1	0	0	0	1	3
	OPERATIONS	0	7865	16762	19928	0	0	5565	0	47920
	RATE/10K	0.0	1.271	0.0	0.502	0.0	0.0	0.0	0.0	0.626
38	FOR									
	EVENTS	0	2	1	7	0	0	2	0	12
	OPERATIONS	0	6756	1753	4402	0	0	9786	0	22698
	RATE/10K	0.0	2.960	5.705	15.902	0.0	0.0	2.044	0.0	5.287
39	SLG									
	EVENTS	0	0	2	2	0	0	0	0	4
	OPERATIONS	0	7767	2908	6966	0	0	690	0	18231
	RATE/10K	0.0	0.0	7.123	2.871	0.0	0.0	0.0	0.0	2.194
40	SUN									
	EVENTS	0	0	0	1	0	0	0	0	1
	OPERATIONS	0	304	0	2761	0	0	0	0	3065
	RATE/10K	0.0	0.0	0.0	3.622	0.0	0.0	0.0	0.0	3.263

AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		----- AIRCRAFT TYPE -----								OVER-ALL
		1	2	3	4	5	6	7	8	
41	GVA	EVENTS	0	0	1	0	0	0	0	1
		OPERATIONS	0	4382	475	1820	0	0	1057	7733
		RATE/10K	0.0	0.0	21.053	0.0	0.0	0.0	0.0	1.293
42	MAN	EVENTS	0	0	1	1	0	0	0	2
		OPERATIONS	0	28	2480	2311	0	0	0	5019
		RATE/10K	0.0	0.0	4.032	3.982	0.0	0.0	0.0	3.983
43	MYB	EVENTS	0	0	0	0	0	1	0	1
		OPERATIONS	0	0	0	122	0	0	1887	2009
		RATE/10K	0.0	0.0	0.0	0.0	0.0	5.299	0.0	4.978
44	MKB	EVENTS	0	0	1	4	0	0	0	5
		OPERATIONS	0	5238	8341	20039	0	211	7634	41505
		RATE/10K	0.0	0.0	1.196	1.994	0.0	0.0	0.0	1.205
45	MLP	EVENTS	0	1	0	0	0	0	0	1
		OPERATIONS	0	8904	4775	3491	0	0	9	17379
		RATE/10K	0.0	1.123	0.0	0.0	0.0	0.0	0.0	0.575
46	MWB	EVENTS	0	3	1	10	0	0	1	15
		OPERATIONS	0	9876	5778	29694	0	0	2027	45874
		RATE/10K	0.0	3.038	1.731	5.368	0.0	0.0	4.933	2.277
47	MYB	EVENTS	0	0	5	0	0	0	0	5
		OPERATIONS	0	0	3232	0	0	0	0	3232
		RATE/10K	0.0	0.0	15.470	0.0	0.0	0.0	0.0	15.470
48	140	EVENTS	0	1	0	0	0	0	0	1
		OPERATIONS	0	4471	0	2904	0	380	723	10482
		RATE/10K	0.0	1.545	0.0	0.0	0.0	0.0	0.0	0.934
49	1AN	EVENTS	0	3	0	0	0	0	0	3
		OPERATIONS	0	6091	1652	3824	0	279	3110	14958
		RATE/10K	0.0	4.925	0.0	0.0	0.0	0.0	0.0	2.006
50	1ST	EVENTS	0	1	0	1	0	0	0	2
		OPERATIONS	0	1707	513	474	0	0	157	2851
		RATE/10K	0.0	5.858	0.0	21.097	0.0	0.0	0.0	7.015

AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		AIRCRAFT TYPE								
		1	2	3	4	5	6	7	8	OVER-ALL
51	JED									
	EVENTS	0	0	0	3	0	0	0	0	3
	OPERATIONS	0	1883	2564	8200	0	0	12452	0	25119
	RATE/10K	0.0	0.0	0.0	3.659	0.0	0.0	0.0	0.0	1.194
52	JFK									
	EVENTS	0	5	1	12	0	0	5	0	23
	OPERATIONS	0	30418	4897	53530	0	463	27661	0	116769
	RATE/10K	0.0	1.644	2.042	2.250	0.0	0.0	1.808	0.0	1.970
53	JNB									
	EVENTS	0	0	0	4	0	0	0	0	4
	OPERATIONS	0	1332	10302	4490	0	0	31	0	16135
	RATE/10K	0.0	0.0	0.0	8.909	0.0	0.0	0.0	0.0	2.476
54	KAM									
	EVENTS	0	3	0	0	0	0	0	0	3
	OPERATIONS	0	3622	73	1146	0	0	0	0	4841
	RATE/10K	0.0	8.283	0.0	0.0	0.0	0.0	0.0	0.0	6.197
55	KNI									
	EVENTS	0	0	3	4	0	0	3	0	10
	OPERATIONS	0	4113	5505	5595	0	0	2092	0	17013
	RATE/10K	0.0	0.0	5.450	7.149	0.0	0.0	14.340	0.0	5.878
56	KNB									
	EVENTS	0	0	0	0	0	0	1	0	1
	OPERATIONS	0	0	0	2183	0	0	1842	0	4025
	RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	5.429	0.0	2.484
57	KRT									
	EVENTS	0	0	1	0	0	0	0	0	1
	OPERATIONS	0	14	557	0	0	0	1169	0	1740
	RATE/10K	0.0	0.0	17.953	0.0	0.0	0.0	0.0	0.0	5.747
58	KUL									
	EVENTS	0	0	0	1	0	0	0	0	1
	OPERATIONS	0	3420	9133	2615	0	0	1049	0	16217
	RATE/10K	0.0	0.0	0.0	3.824	0.0	0.0	0.0	0.0	0.617
59	LAX									
	EVENTS	0	5	0	2	0	0	0	0	7
	OPERATIONS	0	47030	1870	32124	0	804	21199	0	103027
	RATE/10K	0.0	1.063	0.0	0.623	0.0	0.0	0.0	0.0	0.679
60	LCA									
	EVENTS	0	0	0	0	0	0	1	0	1
	OPERATIONS	0	429	0	0	0	307	0	0	736
	RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.684

AIRPORT: BERB INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)									
		1	2	3	4	5	6	7	8	OVER-ALL	
61	LGA										
	EVENTS	0	0	3	0	0	0	1	0	4	
	OPERATIONS	0	4089	14545	0	121	1653	6590	0	27005	
	RATE/10K	0.0	0.0	2.063	0.0	0.0	0.0	1.516	0.0	1.481	
62	LGB										
	EVENTS	0	2	0	1	0	0	0	0	3	
	OPERATIONS	0	8157	0	3905	0	0	1853	0	13925	
	RATE/10K	0.0	2.452	0.0	2.561	0.0	0.0	0.0	0.0	2.154	
63	LHE										
	EVENTS	0	1	2	0	0	0	0	0	3	
	OPERATIONS	0	536	2021	0	0	0	0	0	2577	
	RATE/10K	0.0	17.986	9.896	0.0	0.0	0.0	0.0	0.0	11.641	
64	LHR										
	EVENTS	0	0	0	10	0	0	3	0	13	
	OPERATIONS	0	2927	11297	32592	1235	0	16612	0	64731	
	RATE/10K	0.0	0.0	0.0	3.068	0.0	0.0	1.806	0.0	2.008	
65	LIR										
	EVENTS	0	0	0	0	0	0	1	0	1	
	OPERATIONS	0	2996	0	1573	0	0	1060	0	5629	
	RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	9.434	0.0	1.777	
66	LIN										
	EVENTS	0	1	1	0	0	0	0	0	2	
	OPERATIONS	0	0	2062	0	0	0	185	0	2247	
	RATE/10K	0.0	0.0	4.850	0.0	0.0	0.0	0.0	0.0	8.901	
67	LIS										
	EVENTS	0	0	0	1	0	0	1	0	2	
	OPERATIONS	0	3967	399	1184	0	0	940	0	6450	
	RATE/10K	0.0	0.0	0.0	8.446	0.0	0.0	10.638	0.0	3.110	
68	LBS										
	EVENTS	0	2	0	1	0	0	0	0	3	
	OPERATIONS	0	6520	20	1440	0	0	0	0	7980	
	RATE/10K	0.0	3.067	0.0	6.944	0.0	0.0	0.0	0.0	3.759	
69	LPA										
	EVENTS	0	0	2	0	0	0	0	0	2	
	OPERATIONS	0	421	1163	1140	0	0	0	0	2724	
	RATE/10K	0.0	0.0	17.197	0.0	0.0	0.0	0.0	0.0	7.342	
70	LUX										
	EVENTS	0	0	0	1	0	0	0	0	1	
	OPERATIONS	0	138	0	418	0	0	0	0	556	
	RATE/10K	0.0	0.0	0.0	23.923	0.0	0.0	0.0	0.0	17.986	

AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(<----- AIRCRAFT TYPE ----->)									
		1	2	3	4	5	6	7	8	OVER-ALL	
71	LVS										
	EVENTS	0	0	5	2	0	0	0	0	7	
	OPERATIONS	0	191	3471	601	0	0	0	0	3863	
	RATE/10K	0.0	0.0	16.281	33.278	0.0	0.0	0.0	0.0	18.121	
72	RAA										
	EVENTS	0	0	2	0	0	0	0	0	2	
	OPERATIONS	0	448	2812	0	0	0	0	0	3260	
	RATE/10K	0.0	0.0	7.112	0.0	0.0	0.0	0.0	0.0	6.098	
73	RAJ										
	EVENTS	0	1	0	0	0	0	0	0	1	
	OPERATIONS	0	6939	7684	5651	0	0	61	0	20333	
	RATE/10K	0.0	1.441	0.0	0.0	0.0	0.0	0.0	0.0	0.492	
74	REL										
	EVENTS	0	0	1	3	0	0	0	0	4	
	OPERATIONS	0	1744	5491	10485	0	0	0	0	17720	
	RATE/10K	0.0	0.0	1.821	2.861	0.0	0.0	0.0	0.0	2.257	
75	REI										
	EVENTS	0	1	0	0	0	0	0	0	1	
	OPERATIONS	0	11372	0	3376	0	0	2119	0	17046	
	RATE/10K	0.0	0.879	0.0	0.0	0.0	0.0	0.0	0.0	0.586	
76	RBO										
	EVENTS	0	1	0	0	0	0	0	0	1	
	OPERATIONS	0	202	0	0	0	0	0	0	202	
	RATE/10K	0.0	49.505	0.0	0.0	0.0	0.0	0.0	0.0	49.505	
77	RHA										
	EVENTS	0	1	2	1	0	0	1	0	5	
	OPERATIONS	0	15198	13477	10061	297	334	25946	0	64913	
	RATE/10K	0.0	0.658	1.529	0.996	0.0	0.0	0.385	0.0	0.770	
78	RHL										
	EVENTS	0	0	0	2	0	0	0	0	2	
	OPERATIONS	0	3629	4021	6162	0	21	1719	0	15351	
	RATE/10K	0.0	0.0	0.0	3.246	0.0	0.0	0.0	0.0	1.286	
79	RPL										
	EVENTS	0	0	3	0	0	0	0	0	3	
	OPERATIONS	0	0	1442	0	0	0	0	0	1442	
	RATE/10K	0.0	0.0	20.804	0.0	0.0	0.0	0.0	0.0	20.804	
80	RRS										
	EVENTS	0	0	2	0	0	0	0	0	2	
	OPERATIONS	0	971	6879	1221	0	0	0	0	9071	
	RATE/10K	0.0	0.0	2.907	0.0	0.0	0.0	0.0	0.0	2.285	

AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)									
		1	2	3	4	5	6	7	8	OVER-ALL	
81	WSP										
	EVENTS	0	1	0	0	0	0	0	0	1	
	OPERATIONS	0	10708	0	2514	0	143	122	0	13344	
	RATE/10K	0.0	0.927	0.0	0.0	0.0	0.0	0.0	0.0	0.737	
82	MSV										
	EVENTS	0	0	0	0	0	0	1	0	1	
	OPERATIONS	0	295	0	0	16	136	4031	0	4478	
	RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	2.481	0.0	2.233	
83	NTV										
	EVENTS	0	1	0	0	0	0	0	0	1	
	OPERATIONS	0	2767	0	0	0	0	0	0	2767	
	RATE/10K	0.0	3.614	0.0	0.0	0.0	0.0	0.0	0.0	3.614	
84	HVB										
	EVENTS	0	0	0	1	0	0	0	0	1	
	OPERATIONS	0	867	771	470	0	0	55	0	2163	
	RATE/10K	0.0	0.0	0.0	21.277	0.0	0.0	0.0	0.0	4.623	
85	MMH										
	EVENTS	0	0	0	5	0	0	0	0	5	
	OPERATIONS	0	0	0	39167	0	0	0	0	39167	
	RATE/10K	0.0	0.0	0.0	1.270	0.0	0.0	0.0	0.0	1.276	
86	RIP										
	EVENTS	0	0	0	2	0	0	0	0	2	
	OPERATIONS	0	3704	354	2530	0	0	0	0	6696	
	RATE/10K	0.0	0.0	0.0	7.819	0.0	0.0	0.0	0.0	2.987	
87	WDO										
	EVENTS	0	1	0	7	0	0	0	0	8	
	OPERATIONS	0	2276	0	5491	0	0	0	0	7767	
	RATE/10K	0.0	4.394	0.0	12.748	0.0	0.0	0.0	0.0	10.300	
88	NCE										
	EVENTS	0	0	2	0	0	0	0	0	2	
	OPERATIONS	0	677	7946	649	0	0	442	0	9734	
	RATE/10K	0.0	0.0	2.517	0.0	0.0	0.0	0.0	0.0	2.053	
89	WDO										
	EVENTS	0	1	0	0	0	0	1	0	2	
	OPERATIONS	0	123	362	56	0	0	3904	0	4445	
	RATE/10K	0.0	81.301	0.0	0.0	0.0	0.0	2.561	0.0	4.499	
90	NBS										
	EVENTS	0	0	0	1	0	0	4	0	5	
	OPERATIONS	0	0	790	1330	0	0	3721	0	5841	
	RATE/10K	0.0	0.0	0.0	7.407	0.0	0.0	10.750	0.0	8.331	

AIRPORT: DIBOS INDEXTION EVENTS, OPERATIONS AND INDEXTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)								OVER-ALL
		1	2	3	4	5	6	7	8	
91	MIN									
	EVENTS	0	1	0	0	0	0	0	0	1
	OPERATIONS	0	1127	15	364	0	0	0	0	1506
	RATE/10K	0.0	0.873	0.0	0.0	0.0	0.0	0.0	0.0	6.640
92	NKC									
	EVENTS	0	0	1	0	0	0	0	0	1
	OPERATIONS	0	227	736	0	0	0	0	0	462
	RATE/10K	0.0	0.0	42.373	0.0	0.0	0.0	0.0	0.0	21.645
93	NRT									
	EVENTS	0	0	0	2	0	0	0	0	2
	OPERATIONS	0	7609	2160	42609	0	0	1223	0	53769
	RATE/10K	0.0	0.0	0.0	0.469	0.0	0.0	0.0	0.0	0.372
94	OKK									
	EVENTS	0	1	0	0	0	0	0	0	1
	OPERATIONS	0	2952	0	129	0	0	0	0	3081
	RATE/10K	0.0	3.308	0.0	0.0	0.0	0.0	0.0	0.0	3.246
95	OKA									
	EVENTS	0	1	0	1	0	0	0	0	2
	OPERATIONS	0	3015	160	4741	0	0	4460	0	12584
	RATE/10K	0.0	3.317	0.0	2.109	0.0	0.0	0.0	0.0	1.589
96	ORP									
	EVENTS	0	2	0	0	0	0	0	0	2
	OPERATIONS	0	51679	230	18170	70	2843	6577	0	79604
	RATE/10K	0.0	0.387	0.0	0.0	0.0	0.0	0.0	0.0	0.251
97	ORT									
	EVENTS	1	0	17	4	0	0	0	0	22
	OPERATIONS	0	2299	30925	6770	0	0	1694	0	41689
	RATE/10K	0.0	0.0	3.497	3.908	0.0	0.0	0.0	0.0	3.277
98	ORR									
	EVENTS	0	1	0	0	0	0	1	0	6
	OPERATIONS	0	11418	3920	22101	0	0	18028	0	53474
	RATE/10K	0.0	0.876	0.0	1.810	0.0	0.0	0.935	0.0	1.082
99	PBI									
	EVENTS	0	0	0	0	1	0	0	0	1
	OPERATIONS	0	2133	782	32	30	247	2709	0	3953
	RATE/10K	0.0	0.0	0.0	0.0	333.333	0.0	0.0	0.0	1.680
100	PEN									
	EVENTS	0	0	2	0	0	0	0	0	2
	OPERATIONS	0	692	3366	0	0	0	667	0	4475
	RATE/10K	0.0	0.0	6.831	0.0	0.0	0.0	0.0	0.0	6.469

AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)								OVER-ALL
		1	2	3	4	5	6	7	8	
101	PIL	EVENTS	0	0	0	0	0	3	0	3
		OPERATIONS	0	6636	1997	929	0	213	7237	0 17013
		RATE/10K	0.0	0.0	0.0	0.0	0.0	4.105	0.0	1.763
102	POS	EVENTS	0	0	0	0	0	1	0	1
		OPERATIONS	0	1333	287	543	0	0	2212	0 4375
		RATE/10K	0.0	0.0	0.0	0.0	0.0	4.521	0.0	2.286
103	PTY	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	2350	0	262	0	0	1163	0 3775
		RATE/10K	0.0	0.0	0.0	38.160	0.0	0.0	0.0	2.649
104	PUS	EVENTS	0	0	1	1	0	0	0	2
		OPERATIONS	0	794	1796	0	0	0	0	0 2390
		RATE/10K	0.0	0.0	5.568	0.0	0.0	0.0	0.0	7.722
105	SCL	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	1729	244	1018	0	0	1193	0 4184
		RATE/10K	0.0	0.0	0.0	9.823	0.0	0.0	0.0	2.390
106	SCQ	EVENTS	0	0	0	0	0	0	1	1
		OPERATIONS	0	0	0	50	0	0	0	0 50
		RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200.000
107	SEA	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	16298	1404	5385	30	260	6766	0 30143
		RATE/10K	0.0	0.0	0.0	1.857	0.0	0.0	0.0	0.332
108	SEL	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	2664	6757	7821	0	43	37	0 17322
		RATE/10K	0.0	0.0	0.0	1.279	0.0	0.0	0.0	0.577
109	SFO	EVENTS	0	0	0	3	0	0	1	4
		OPERATIONS	0	20172	2983	15806	0	1100	11450	0 51518
		RATE/10K	0.0	0.0	0.0	1.898	0.0	0.0	0.873	0.0 0.776
110	SID	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	0	0	2030	0	0	0	0 2030
		RATE/10K	0.0	0.0	0.0	4.926	0.0	0.0	0.0	4.926

AIRPORT: BIRDS IMBESION EVENTS, OPERATIONS AND IMBESION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)								
		1	2	3	4	5	6	7	8	OVER-ALL
111	SIN	EVENTS	0	0	0	1	0	0	0	1
		OPERATIONS	0	9332	16721	10001	0	0	1247	0 49301
		RATE/10K	0.0	0.0	0.0	0.333	0.0	0.0	0.0	0.219
112	SUN	EVENTS	0	1	0	3	0	0	0	4
		OPERATIONS	0	131	0	2633	0	0	0	2764
		RATE/10K	0.0	76.334	0.0	11.396	0.0	0.0	0.0	14.472
113	SSA	EVENTS	0	1	0	0	0	0	0	1
		OPERATIONS	0	431	200	0	0	0	0	711
		RATE/10K	0.0	23.202	0.0	0.0	0.0	0.0	0.0	14.065
114	STR	EVENTS	0	0	1	0	0	0	0	1
		OPERATIONS	0	0	1319	0	0	0	0	1319
		RATE/10K	0.0	0.0	7.581	0.0	0.0	0.0	0.0	7.581
115	SUB	EVENTS	0	0	1	0	0	0	0	1
		OPERATIONS	0	0	2378	0	0	0	0	2378
		RATE/10K	0.0	0.0	4.205	0.0	0.0	0.0	0.0	4.205
116	SXR	EVENTS	0	0	2	0	0	0	0	2
		OPERATIONS	0	0	657	0	0	0	0	657
		RATE/10K	0.0	0.0	30.441	0.0	0.0	0.0	0.0	30.441
117	SYD	EVENTS	0	0	0	6	0	0	0	6
		OPERATIONS	0	2666	6769	18196	0	0	0	27631
		RATE/10K	0.0	0.0	0.0	3.297	0.0	0.0	0.0	2.171
118	TNR	EVENTS	0	0	1	0	0	0	0	1
		OPERATIONS	0	213	2703	767	0	0	0	4783
		RATE/10K	0.0	0.0	2.701	0.0	0.0	0.0	0.0	2.091
119	TLB	EVENTS	0	0	3	0	0	0	0	6
		OPERATIONS	0	0	3373	0	0	0	0	3373
		RATE/10K	0.0	0.0	13.996	0.0	0.0	0.0	0.0	16.793
120	TLV	EVENTS	0	0	0	2	0	0	0	2
		OPERATIONS	0	657	1227	2721	0	0	1593	6200
		RATE/10K	0.0	0.0	0.0	7.330	0.0	0.0	0.0	3.226

AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		(----- AIRCRAFT TYPE -----)								OVER-ALL
		1	2	3	4	5	6	7	8	
121	TBR									
	EVENTS	0	0	0	1	0	0	0	0	1
	OPERATIONS	0	0	0	656	0	0	0	0	656
	RATE/10K	0.0	0.0	0.0	15.244	0.0	0.0	0.0	0.0	15.244
122	TPE									
	EVENTS	0	0	0	2	0	0	0	0	2
	OPERATIONS	0	2541	7845	10664	0	109	4542	0	25780
	RATE/10K	0.0	0.0	0.0	1.075	0.0	0.0	0.0	0.0	0.776
123	TRV									
	EVENTS	0	0	2	0	0	0	0	0	2
	OPERATIONS	0	0	1055	0	0	0	0	0	1055
	RATE/10K	0.0	0.0	18.957	0.0	0.0	0.0	0.0	0.0	18.957
124	TSV									
	EVENTS	0	0	0	1	0	0	0	0	1
	OPERATIONS	0	0	0	193	0	0	0	0	193
	RATE/10K	0.0	0.0	0.0	51.813	0.0	0.0	0.0	0.0	51.813
125	TUL									
	EVENTS	0	0	0	0	0	1	0	0	1
	OPERATIONS	0	26	0	26	0	0	0	0	52
	RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192.508
126	TUN									
	EVENTS	0	0	1	0	0	0	0	0	1
	OPERATIONS	0	0	1575	0	0	0	106	0	1481
	RATE/10K	0.0	0.0	7.275	0.0	0.0	0.0	0.0	0.0	6.752
127	VCP									
	EVENTS	0	1	0	1	0	0	0	0	2
	OPERATIONS	0	2470	0	1750	0	0	59	0	4279
	RATE/10K	0.0	4.049	0.0	5.714	0.0	0.0	0.0	0.0	4.674
128	VIE									
	EVENTS	0	0	1	1	0	0	0	0	2
	OPERATIONS	0	218	784	1369	0	0	0	0	2371
	RATE/10K	0.0	0.0	12.755	7.505	0.0	0.0	0.0	0.0	8.455
129	WBN									
	EVENTS	0	0	0	1	0	0	0	0	1
	OPERATIONS	0	0	0	26	0	0	0	0	26
	RATE/10K	0.0	0.0	0.0	384.615	0.0	0.0	0.0	0.0	384.615
130	MLB									
	EVENTS	0	0	0	1	0	0	0	0	1
	OPERATIONS	0	6102	1130	22035	0	0	0	0	29267
	RATE/10K	0.0	0.0	0.0	6.654	0.0	0.0	0.0	0.0	6.342

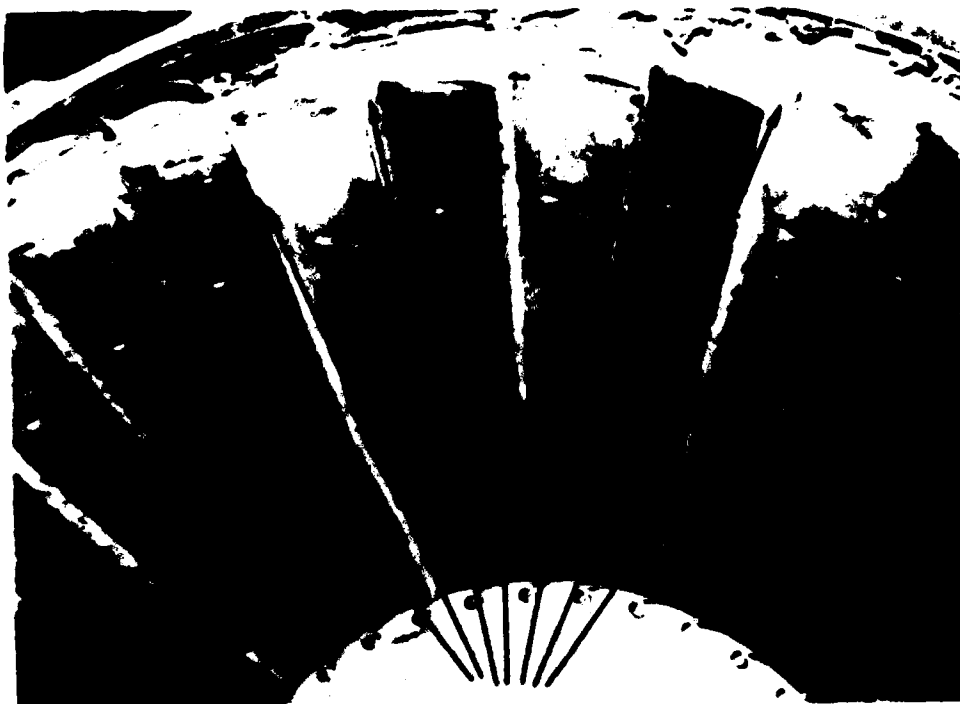
AIRPORT: BIRDS INGESTION EVENTS, OPERATIONS AND INGESTION RATES/10K OPERATIONS BY AIRCRAFT TYPES

		----- AIRCRAFT TYPE -----								OVER-ALL	
		1	2	3	4	5	6	7	8		
131	ZFB	EVENTS	0	16	36	67	0	0	17	0	136
		OPERATIONS	0	0	0	0	0	0	0	0	0
		RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
132	ZUS	EVENTS	1	4	4	7	0	1	0	0	25
		OPERATIONS	0	0	0	0	0	0	0	0	0
		RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
133	111	EVENTS	0	6	1	29	0	0	11	0	47
		OPERATIONS	0	0	0	0	0	0	0	0	0
		RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
134	YRI	EVENTS	0	0	0	1	0	0	1	0	2
		OPERATIONS	0	3702	0	6715	0	0	1403	0	11820
		RATE/10K	0.0	0.0	0.0	1.409	0.0	0.0	7.128	0.0	1.692
135	YUL	EVENTS	0	1	0	1	0	0	4	0	6
		OPERATIONS	0	715	578	197	0	180	5371	0	7041
		RATE/10K	0.0	13.906	0.0	30.761	0.0	0.0	7.447	0.0	8.322
136	YVR	EVENTS	0	0	0	4	0	1	2	0	7
		OPERATIONS	0	2616	0	3039	0	161	3450	0	9266
		RATE/10K	0.0	0.0	0.0	13.162	0.0	62.112	5.797	0.0	7.354
137	YYC	EVENTS	0	0	0	0	0	0	1	0	1
		OPERATIONS	0	2267	0	262	0	186	3034	0	5748
		RATE/10K	0.0	0.0	0.0	0.0	0.0	0.0	3.296	0.0	1.740
138	YYZ	EVENTS	0	1	0	2	0	0	3	0	6
		OPERATIONS	0	7378	358	5332	0	420	11473	0	24982
		RATE/10K	0.0	1.335	0.0	3.737	0.0	0.0	2.615	0.0	2.402
139	ZBN	EVENTS	0	2	0	2	0	0	0	0	4
		OPERATIONS	0	7737	76	4546	0	0	946	0	13124
		RATE/10K	0.0	2.985	0.0	4.581	0.0	0.0	0.0	0.0	3.048

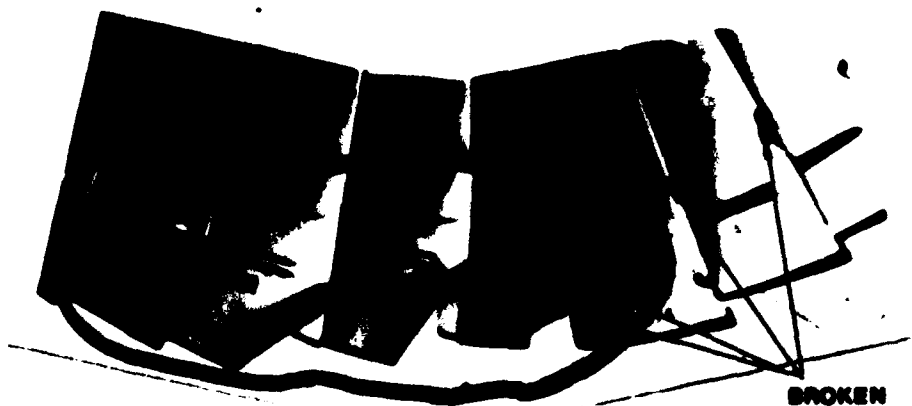
APPENDIX I
ENGINE DAMAGE PICTURES



FIGURE I-1. TYPICAL DAMAGE EVENTS (CATEGORY 2)



**BROKEN
FAN BLADES**



**BROKEN
FAN BLADES**

FIGURE I-2. TYPICAL DAMAGE EVENTS (CATEGORY 4)

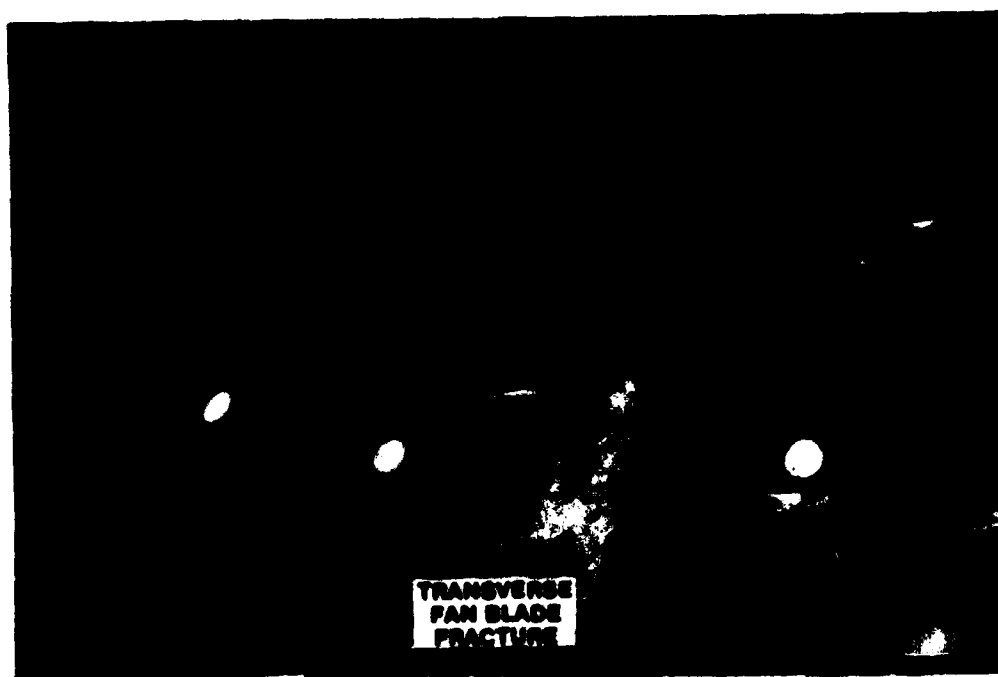


FIGURE I-3. TYPICAL DAMAGE EVENTS (CATEGORY 5)

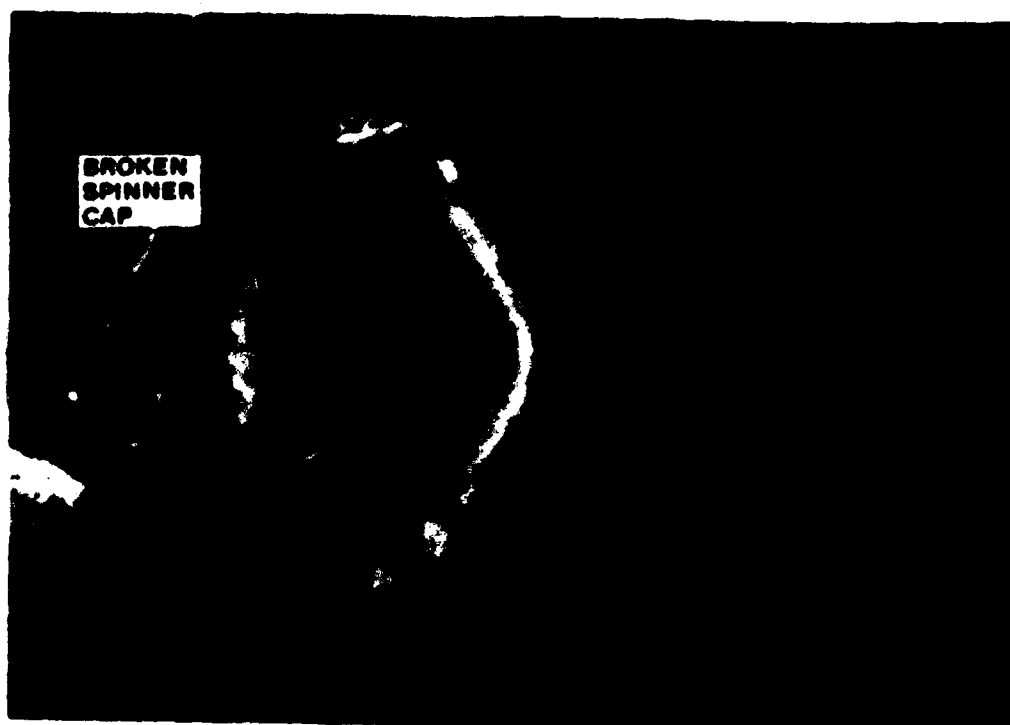


FIGURE I-4. TYPICAL DAMAGE EVENTS (CATEGORY 6)

BROKEN COMPRESSOR BLADES

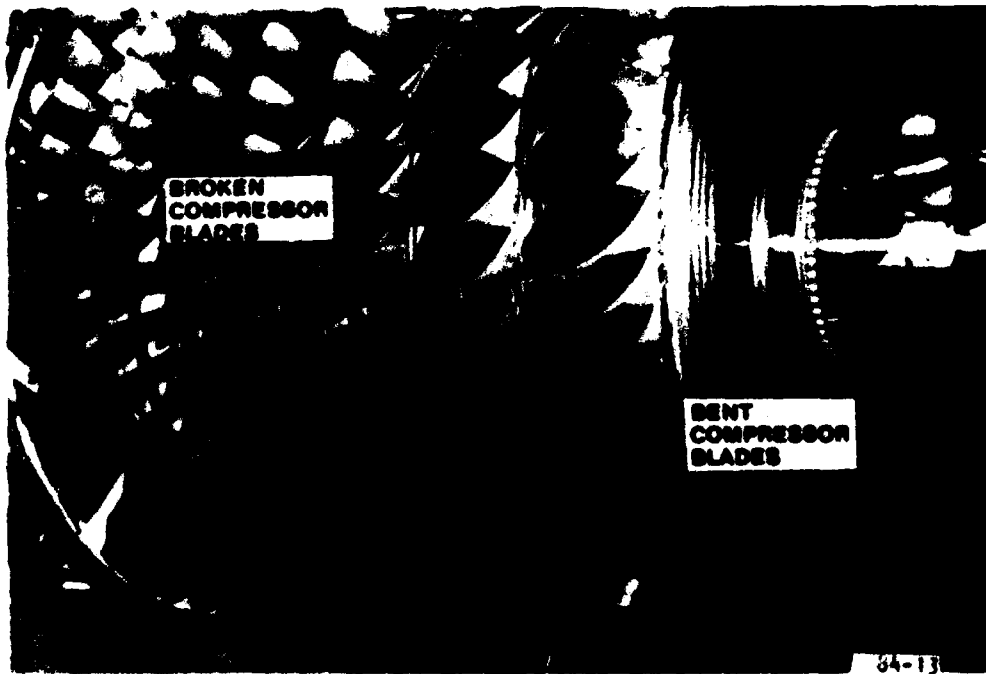


FIGURE 1-5. TYPICAL DAMAGE EVENTS (CATEGORY 7)

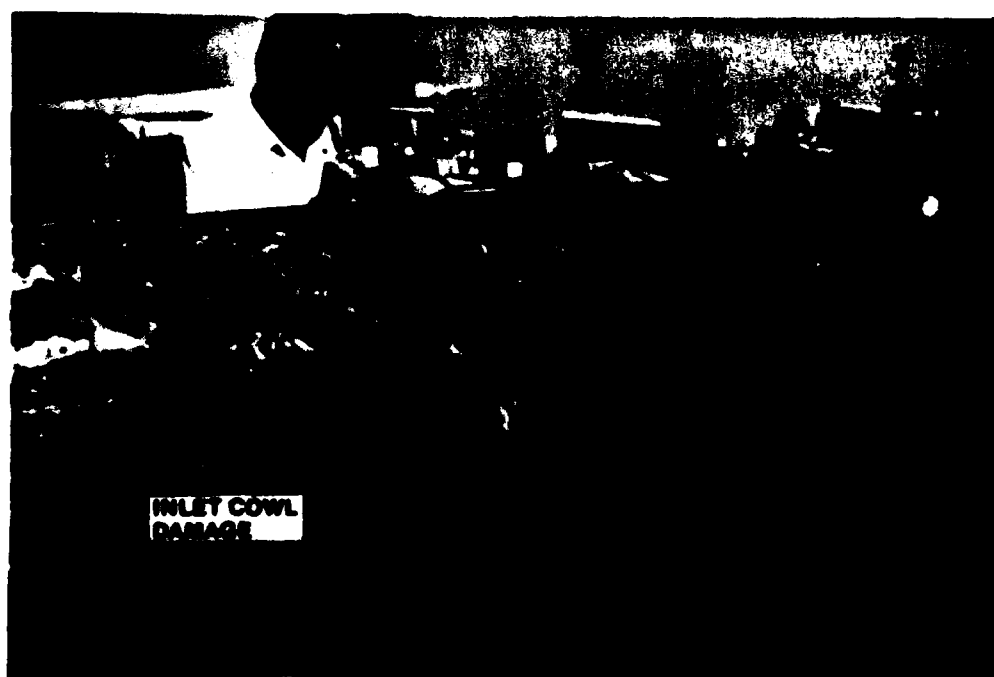
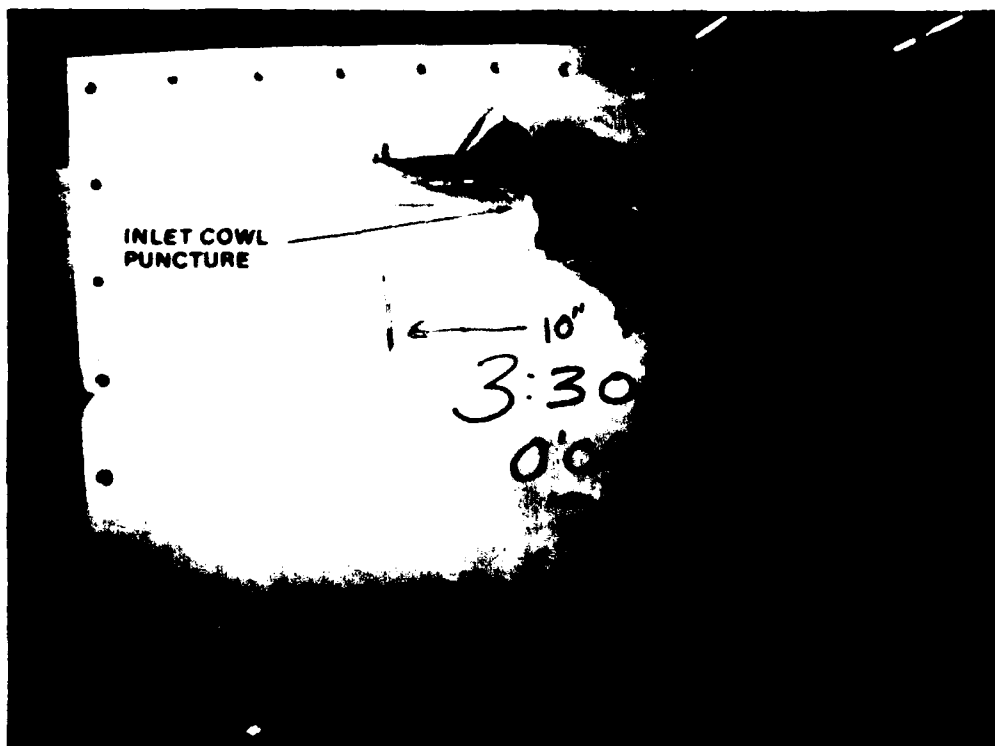


FIGURE I-6. TYPICAL DAMAGE EVENTS (CATEGORY 8)

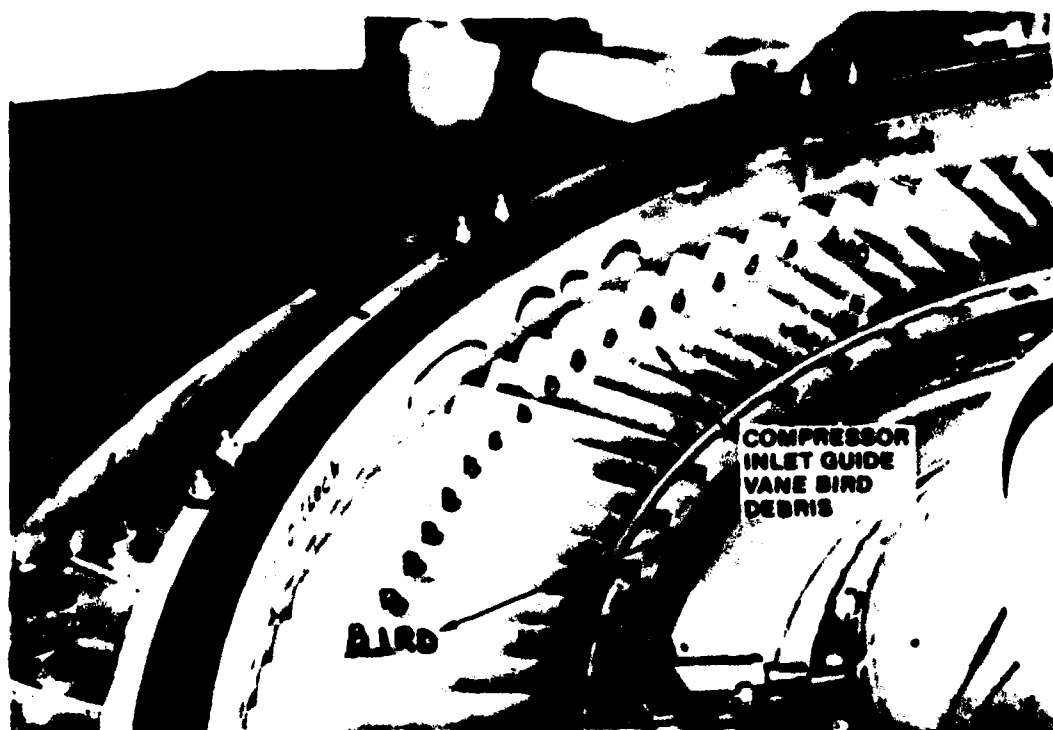


FIGURE I-7. TYPICAL DAMAGE EVENTS (CATEGORY 9)

